U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

October 2002

Dear Members of the Aviation Community:

I am pleased to present the enclosed *Blueprint for NAS Modernization, 2002 Update*, the Federal Aviation Administration's (FAA) overview of the evolving National Airspace System (NAS) Architecture. The NAS Architecture is the U.S. aviation community's comprehensive plan for improving the NAS over the next 15 years, and the 2002 Update summarizes current NAS programs and initiatives, as well as future plans to modernize the NAS. The NAS Architecture is developed in continuing collaboration with the aviation community. This collaboration helps ensure that we take rational, affordable, and feasible approaches to modernization that can be achieved without disruption of critical aviation services.

To expedite the transfer of detailed information to the aviation community, the FAA no longer produces a print version of the entire NAS Architecture. Instead, the FAA makes comprehensive architecture information available on a public Web site using the Capability Architecture Tool Suite - Internet (CATS-I) at http://www.nas-architecture.faa.gov/cats.

This CATS-I tool provides both Government and industry with not only the capability to maintain a long-term planning horizon, but also to make adjustments to the architecture when required: for example, when national security needs caused the FAA to reevaluate the allocation of funds and priorities to enhance aviation safety, security, and system efficiency. Valuable input from all stakeholders, when national priorities or economic forces shift, is key to sound, joint investment decisionmaking for NAS modernization.

Our citizens continue to demand safe, secure, and efficient air travel, and the FAA is committed to meeting these demands. The NAS Architecture is the blueprint for enhancing our aviation services while maintaining a sound infrastructure. On behalf of the FAA, thank you, the members of the aviation community, for working so diligently with us to modernize the NAS and define its evolution. I look forward to working with you on continuing this important mission.

Marion C. Blakey
FAA Administrator

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Throughout this document, 💻 indicates that a Web address is provided for related information. Please see Related Web Sites for a list of these URLs, or see http://www.faa.gov/nasarchitecture/BlueprintURLs.htm for a continually maintained version of the list.

This document has been prepared by the Office of System Architecture and Investment Analysis.

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Commercial aircraft at gate

1. Introduction

America's aviation industry is soaring into the 21st century with projected increases in business, recreation, and personal travel. According to the *Federal Aviation Administration (FAA) Aerospace Forecasts 2002-2013*, released in March 2002, domestic operations (e.g., takeoffs or landings) are expected to increase from over 66 million in 2001 to more than 81 million in 2013.

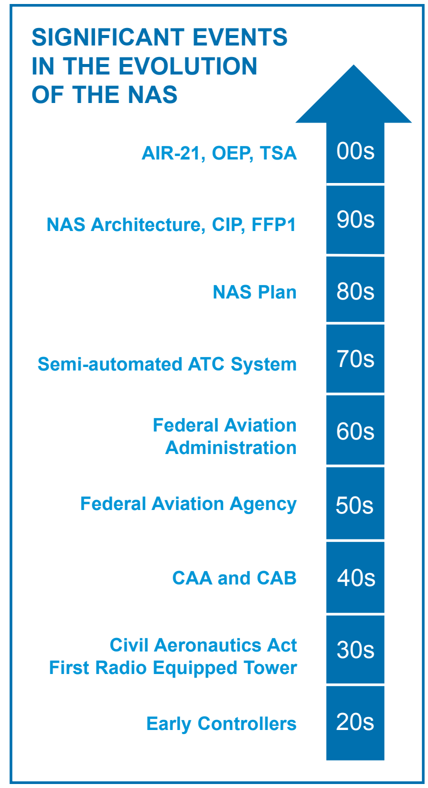
While recent tragic events have curtailed short-term growth in the aviation industry, all indications strongly suggest that growth will resume by 2004. The National Airspace System (NAS) must be modernized via a coordinated, long-term plan to support increasing air traffic.

"New and revolutionary technologies hold undeniable and exciting possibilities for flight and safety, and keeping pace with advanced technology is the key."

Norman Y. Mineta,
Secretary
U.S. Department of Transportation

History of Air Traffic Control (ATC)

Air Traffic Control (ATC) began in the U.S. in the late 1920s, pioneered by airport employees like Archie League and William "Whitey" Conrad. Early controllers used flags and lights to signal their instructions to pilots. In 1930, Cleveland became the first city to boast a radio-equipped control tower.



As traffic increased, the need to ensure separation of flights moving between cities grew. Encouraged by the Federal government, an airline consortium established the first three centers for this purpose between December 1935 and June 1936. The Bureau of Air Commerce, within the Department of Commerce (DOC), took over operation of the three facilities when it assumed responsibility for En Route ATC in July 1936. Pioneer air traffic controllers used maps, blackboards, and mental calculations to ensure the safe separation of aircraft traveling between cities along designated routes.

In 1938, the Civil Aeronautics Act transferred Federal civil aviation responsibilities from the DOC to a new independent agency, the Civil Aeronautics Authority. In 1940, President Franklin Roosevelt split the Authority into two agencies, the Civil Aeronautics Administration (CAA) and the Civil Aeronautics Board (CAB) and placed them under the DOC. The CAA was responsible for ATC, airman and aircraft certification, safety enforcement, and airway development. The CAB was entrusted with safety rulemaking, accident investigation, and economic regulation of the airlines. On the eve of America's entry into World War II, the Federal government also began to assume operation of major airport towers, a responsibility that became permanent in the postwar era.

The introduction of jet airliners and a series of midair collisions spurred passage of the Federal Aviation Act of 1958. This legislation transferred CAA functions to a new independent body, the Federal Aviation Agency. The agency was given sole responsibility to develop and maintain a common civil-military system of air navigation and ATC. The Act also transferred safety rulemaking from the CAB to the Federal Aviation Agency. On April 1, 1967, the Federal Aviation Agency became one of several organizations within the Department of Transportation (DOT) and became the Federal Aviation Administration (FAA).

By the mid-1970s, the FAA achieved a semi-automated ATC system based on a combination of radar and computer technology. By automating certain routine tasks, the system allowed controllers to concentrate more efficiently on the vital task of aircraft separation. Data appearing directly on the controllers' scopes provided the identity, altitude, and groundspeed of aircraft carrying radar beacons. Despite its effectiveness, this system required enhancement to keep pace with increasing air traffic.

To meet this traffic growth challenge, the FAA unveiled the NAS Plan in January 1982. This plan called for more advanced systems for En Route and Terminal ATC, modernized flight service stations, and improvements in ground-to-air surveillance and communication.

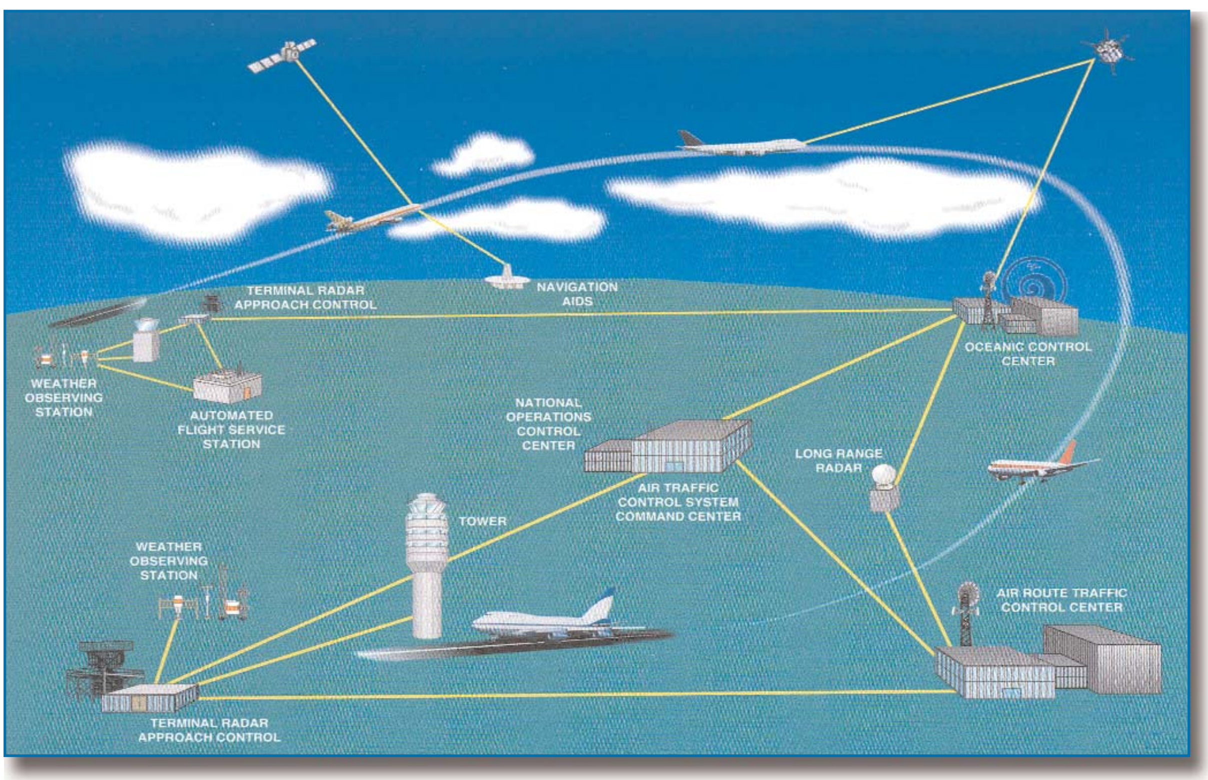
In February 1991, the FAA replaced the NAS Plan with the more comprehensive *National Airspace System Capital Investment Plan* (CIP). This plan included higher levels of automation as well as new radar, communications, and weather systems. In September 1995, the *NAS Architecture Version 1.0*, the plan for NAS modernization and evolution, was released. In January 1999, the *National Airspace System Architecture Version 4.0* was approved by the Administrator of the FAA.

The Administrator established the Free Flight Phase 1 (FFP1) program in October 1998 as the single voice and point-of-contact for a fast-paced modernization effort. FFP1 was the consensus vehicle by which the FAA, with ongoing industry collaboration, would deploy certain low-risk capabilities to selected sites to provide early, measurable benefits to system users.

Legislation in 2000 prompted action to establish a new performance-based organization within the agency with responsibility for air traffic services. Additionally, the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21) was passed. These pieces of legislation were enacted to improve aviation safety, create airline competition, and provide taxpayers with a healthy return on aviation investments.

In 2001, the FAA put in place the *Operational Evolution Plan* (OEP). The OEP represents the FAA commitment to meet the air transportation needs of the U.S. for the next 10 years by increasing capacity, decreasing delays, and continuing to improve safety and security. Developed in concert with the entire aviation community, the OEP addresses four core areas: Arrival and Departure Rate (AD), En Route Congestion (ER), Airport Weather (AW), and En Route Severe Weather (EW).

Following the events of September 11, 2001, Congress created the Transportation Security Administration (TSA), which succeeds the FAA as the agency with primary responsibility for civil aviation security.



National Airspace System overview

The National Airspace System (NAS)

Today's NAS is comprised of a complex network of interconnected systems as well as the people who operate, maintain, and use the systems and detailed procedures and certifications. The NAS includes more than 19,000 airports, 750 ATC facilities, and about 45,000 pieces of equipment that operate unceasingly to provide safe and efficient flight services for users.

The NAS spans the country, extends into the Atlantic, Pacific, and Arctic oceans, and interfaces with neighboring ATC systems for international flights. The NAS supports air transportation commerce that constitutes approximately six percent of the nation's gross domestic product.

Document Scope

This publication provides an overview of the current NAS Architecture as contained in the NAS Architecture Database and an update to the modernization efforts described in the January 1999 *Blueprint for NAS Modernization*.

"The updated National Airspace System Blueprint represents a milestone in the development of aviation. It comes at a significant time of new demands, new growth that we will nurture with cooperation, planning, commitment, and vision."

Charles E. Keegan,
Associate Administrator
Research and Acquisitions

Traffic Situation Display with active national air traffic

2. National Airspace System Modernization

The NAS is among the safest and most secure aviation systems in the world. However, modernization is required for several reasons. First, the move toward Free Flight concepts necessitates equipment with new capabilities and new procedures. The infrastructure must support the unprecedented amount of information being shared between the FAA and NAS users.

Additionally, many current systems are aging. These systems, which have provided years of reliable service, must be maintained to ensure safe operations while also transitioning to future systems. Finally, NAS modernization initiatives leverage technological advances to improve Communications, Navigation, and Surveillance (CNS) and automation systems to support projected air traffic growth.

"Our job is to ensure that aviation works safely and efficiently. If we do that well, people and cargo get where they need to go, the aviation industry thrives, and the National Airspace System serves us all as the strong and healthy lifeblood of the American economy."

Marion C. Blakey,
Administrator
Federal Aviation Administration

The FAA Role in Modernization

The FAA manages the nation's airspace and provides the facilities and services necessary for air commerce. The FAA has established specific goals derived from mission needs.

These goals, identified in the *FAA Strategic Plan*, sustain and upgrade the NAS Architecture in the areas of:

- **Safety:** Reduce fatal aviation accident rates by 80 percent in 10 years;
- **Security:** Prevent security incidents in the aviation system; and
- **System Efficiency:** Provide an aerospace transportation system that meets the needs of users and applies resources efficiently.

FAA MISSION

The FAA provides a safe, secure, and efficient global aerospace system that contributes to national security and the promotion of U.S. aerospace safety.

As the leading authority in the international aerospace community, the FAA is responsive to the dynamic nature of customer needs, economic conditions, and environmental concerns.

The FAA leads, influences, guides, and works with the aviation community to improve the NAS. The aviation community consists of all people and organizations involved in the safe movement of goods and people by aircraft. This includes pilots, controllers, dispatchers, security, mechanics, service personnel, airline companies, passengers, manufacturers, and numerous others in government and private industry.

Concept of the NAS Architecture

The FAA, together with the aviation community, developed the NAS Architecture. Updated by the *NAS Concept of Operations*, December 2000, the NAS Architecture is a 15-year strategic plan that reflects the fundamental organization of the NAS. It includes existing and planned capital investments, their relationships to each other and the environment, and the principles governing their design and evolution.

The NAS Architecture includes the replacement of aging equipment and the introduction of new systems, capabilities, and procedures. It provides a roadmap to increased benefits to all users while increasing safety through new technologies, procedures, and collaboration among users and service providers. The NAS Architecture facilitates continuing dialog on modernization between the FAA and the aviation community.

History of the NAS Architecture

In 1995, the FAA developed the first comprehensive system Architecture for the NAS. The initial NAS Architecture release, Version 1.0, completed in September 1995, was an internal working document developed in parallel with RTCA Task Force 3 on Free Flight. Version 1.0 identified key modernization decisions.

The initial public release of the NAS Architecture Version 1.5, on compact disk only, came in February 1996. This document set forth the concepts and principles of the NAS Architecture and established the direction and methods of the Architecture's evolution.

Major Architecture development continued in 1996 with a focus on resolving several aviation community issues, defining the NAS contents and cost estimates, and developing a transition strategy for NAS Architecture realization. *NAS Architecture Version 2.0*, the first printed version, focused on sustaining existing infrastructure while evolving toward Free Flight. Version 2.0 initiated community-wide discussion about the need for an air traffic services concept of operations for a modernized NAS, aviation community needs, stable funding requirements for the FAA, and the required pace of NAS modernization.

In December 1997, *NAS Architecture Version 3.0* incorporated feedback received from the aviation community and from the air traffic services document, entitled *Concept of Operations for the National Airspace System in 2005*.

In January 1999, *NAS Architecture Version 4.0* was approved by the Administrator. This version incorporated input from the Administrator's Modernization Task Force and more realistic funding profiles for Research, Engineering & Development (R,E&D); Facilities and Equipment (F&E); and Operations. *NAS Architecture Version 4.0*, which covered 1998-2015, was also based on the December 1997 document *Government/Industry Operational Concept for the Evolution of Free Flight*, developed by the RTCA Select Committee on Free Flight Implementation.

The current version of the Architecture is so voluminous that print documents are too cumbersome and static; therefore, the NAS Architecture Database, hosted by the Capability Architecture Tool Suite - Internet (CATS-I), is available via a public Web site. The CATS-I consists of a suite of integrated commercial off-the-shelf (COTS) software products configured with custom applications to provide decision support and systems engineering support necessary to document the NAS Architecture. The CATS-I Web site allows for direct input of comments. Feedback received via the online tool is addressed by the FAA Architecture development team in concert with the aviation community and industry partners.

Structure of the NAS Architecture

NAS Architecture data are divided into programmatic (e.g., costs and schedules) and technical (e.g., concepts, services, capabilities, implementation steps, requirements, and enabling systems) components to meet the FAA mission and to deliver desired services to the aviation community and aviation service providers. Additional information on the programmatic and technical views of the NAS Architecture is available via a tutorial on CATS-I.

Service Hierarchy

The NAS Architecture can be described in terms of a hierarchy of Service Groups, Services, Capabilities, and Implementation Steps as follows:

Service Groups
Service Groups are a collection of related Services. There are six Service Groups used in the NAS Architecture: Air Traffic Services, Safety Services, Certification Services, Airport Management Services, Security Services, and Business Management Services.

Services
Services are high-level activities, performed by the FAA for the aviation community, that contribute to the flow of aircraft throughout the NAS.

Capabilities
Capabilities are functions or related activities that enable or support the delivery of a service.

Implementation Steps
Implementation Steps represent the incremental capability improvements, enabled through the modification or replacement of existing mechanisms or the delivery of new mechanisms, as set in context by operational scenarios.

Implementation Steps can be further broken down into their various components, or *mechanisms*. Mechanisms are the enabling people, support activities, and systems necessary to meet the FAA mission and to deliver desired services to the aviation community. Support activities include procedure development, training, airspace design, certification, standards, and rulemaking. Implementation Steps, together with the scheduled delivery of each incremental capability enhancement, detail the evolutionary plan of the overall Capability.

Modernization Highlights

Several modernization efforts have introduced state-of-the-art equipment into the NAS. Examples include FFP1 and Safe Flight 21 (SF-21). Free Flight Phase 2 (FFP2), recently initiated, will build upon the success of FFP1.

Free Flight Phase 1 (FFP1)

FFP1 resulted from an agreement between the FAA and the aviation community to implement certain highly desired capabilities at selected locations. An important objective of FFP1 was to lessen NAS modernization risks by deploying operational tools at a limited number of sites for performance evaluation. The FFP1 tools include:

- User Request Evaluation Tool (URET) predicts conflicts and helps controllers manage NAS user requests, including altitude, speed, and route change requests, in Kansas City, Memphis, Indianapolis, Cleveland, Chicago, and Washington Air Route Traffic Control Centers (ARTCC). URET is scheduled to be at all En Route centers by 2004.

- Traffic Management Advisor - Single Center (TMA-SC) contributes to fuel savings and reduces delays at Denver, Minneapolis, Fort Worth, Atlanta, Los Angeles, Miami, and Oakland ARTCCs. FFP2 will deploy TMA-SC to additional sites.
- Passive Final Approach Spacing Tool (pFAST) has been returned to research for further development prior to resuming deployment. Center Terminal Radar Approach Control (TRACON) Automation System (CTAS) driven data are being utilized at Southern California TRACON to support situational awareness of traffic flow information.

> "The FAA is delivering on its promise to put new equipment into the hands of the controllers."
>
> John Thornton,
> Director
> FAA Free Flight Program

- FFP1 Surface Movement Advisor (SMA), completed in December 1999, provides real-time Automated Radar Terminal System - Model III (ARTS-III) or Standard Terminal Automation Replacement System (STARS) data about aircraft position and estimated touchdown time in Chicago, Dallas/Fort Worth, Detroit, Newark, Teterboro, and Philadelphia.
- Collaborative Decision Making (CDM), completed ahead of schedule on May 3, 2001, offers real-time access to NAS data for system users including over 30 airlines and NAV CANADA. CDM will be enhanced during FFP2.

Safe Flight 21 (SF-21)

The SF-21 program demonstrates and validates, in a real-world environment, the capabilities of advanced surveillance systems and air traffic procedures associated with Free Flight, using Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services - Broadcast (TIS-B) as enabling technologies. Initiatives are underway in the Ohio River Valley and in the Bethel area of the Alaskan Region (the Capstone program). Results from both the Ohio River Valley and Capstone programs help the FAA validate costs and benefits of ADS-B technologies, and enable the FAA and users to make appropriate investment decisions. The FAA recently announced the selection of an ADS-B architecture that utilizes a combination of the 1090 megahertz (MHz) Extended Squitter ADS-B link for air carrier and private/commercial operators of high-performance airframes, and the Universal Access Transceiver (UAT) ADS-B link for typical general aviation (GA) users.

Ohio River Valley

The SF-21 program in the Ohio River Valley provides an operational evaluation of an integrated ADS-B environment that will support Free Flight operational enhancements. Ohio River Valley activities provide improved aviation capabilities for equipped aircraft and vehicles in the evaluation area, and an infrastructure from which to gather data necessary to implement future Architecture programs. Ohio River Valley evaluations provide answers to technical and cost/benefit questions necessary for FAA/industry decisionmakers to make key CNS technology choices. These answers will help the SF-21 program validate the Free Flight operational enhancements.

Ohio River Valley display

Capstone

Capstone display

The SF-21 Capstone initiative ushered in a new era in aviation safety with the use of ADS-B technology. ADS-B-equipped aircraft, in the Bethel area of the Alaskan Region, broadcast their precise position in space via a digital data link to ground-based transceivers. These transceivers forward the information to the Anchorage ARTCC, where the Micro En Route Automated Radar Tracking System (MicroEARTS) supports ADS-B input processing and display, and is shown on controllers' screens. Additional information, including airspeed and altitude and whether the aircraft is turning, climbing, or descending, is also transmitted.

The first phase of Capstone equipped more than 160 aircraft with a certified Global Positioning System (GPS) navigation receiver, a UAT data link, and a multifunction color display. In addition to the avionics suites, Capstone deploys a ground infrastructure for weather observations, data link communications, surveillance, and Flight Information Services (FIS) to improve safety and enable eventual implementation of new procedures. The transmission of weather information to the cockpit is via the same UAT data link that supports ADS-B. The FAA plans to extend Phase I of the Capstone program through December 31, 2004.

> "ADS-B will provide the ground ATC system and ADS-B-equipped aircraft with a common picture of the air traffic situation. RTCA Task Force 3 believed that the common situational awareness would enable greater efficiencies and safety by giving pilots a greater role in the air traffic control process."
>
> John A. Scardina,
> Director
> Office of System Architecture
> and Investment Analysis

The second phase of the Capstone program is about to begin in the southeast portion of Alaska, centered around Juneau, the state capital. Capstone Phase II will include both a multifunction display and an optional highway-in-the-sky display as part of its avionics package. To support the evaluation of Phase II, up to 200 aircraft will be equipped with the necessary Phase II avionics.

The FAA awarded a contract on April 15, 2002, for avionics to support the agency's Capstone Phase II program in Southeast Alaska. The contract is for state-of-the-art avionics systems, installation kits, and databases covering navigation, obstruction, and terrain. In addition, it includes avionics training simulators and training assistance. The avionics, which include a GPS-based primary flight display and a multifunction navigation display, will be furnished by the FAA to GA and commercial air carriers operating fixed-wing and rotary-wing aircraft in the area that voluntarily participate in the Capstone Phase II program test period for up to three years.

Maintaining the Momentum

Free Flight Phase 2 (FFP2)

FFP2 includes the geographic expansion and enhancement of FFP1 capabilities, including CDM, URET, and TMA-SC. Additionally, FFP2 includes Controller-Pilot Data Link Communications (CPDLC).

The desired benefit of CDM/Collaborative Routing Coordination Tools (CRCT) is to change the way air traffic is managed, prompting a shift from current practice, where the FAA is the service provider and is responsible for traffic decisions, to a collaborative paradigm in which users have input on decisions and all parties are simultaneously aware of NAS constraints. FFP2 will deploy CDM with CRCT functionality on the traffic flow management infrastructure to 20 ARTCCs and the Air Traffic Control System Command Center (ATCSCC) by 2005, as well as to participating Airline Operation Centers (AOC).

FFP2-planned URET enhancements include Alternate Flight Plan Processing, Automation Assisted Dynamic Rerouting, processing of International Civil Aviation Organization (ICAO) flight plans, non-radar airspace capability, and technology refresh of processors, routers, local area networks, and operating systems. FFP2 will expand URET to all ARTCC facilities by 2004. TMA-SC enables En Route controllers and traffic management specialists to develop complete arrival-scheduling plans for controlled aircraft. FFP2 will deploy TMA-SC to Houston, Kansas City, Indianapolis, and Memphis centers.

CPDLC provides for the exchange of digital messages between pilots and controllers as an alternative to voice. The benefits of CPDLC include the ability to transmit ATC information in a reliable, uncluttered medium and reduce voice communication flow on ATC radio frequencies.

FFP2 will also facilitate Research & Development (R&D) on certain key technologies. The following R&D projects will be monitored and evaluated for the purpose of making investment decisions in the 2003-2005 timeframe:

- Direct-To (D2) - A tool designed to assist En Route controllers in identifying aircraft that can have their time en route reduced by flying directly to a downstream point closer to the destination airport. D2 also provides conflict probe, trial planning, and flight plan amendment capabilities for En Route R-side controllers.
- Equitable Allocation of Limited Resources (EALR) - A capability that extends the collaborative rerouting process by providing functionality to balance the assignment of entry into a congested airspace with assignment of reroutings. The capability ensures equity within an individual initiative as well as across several days.
- Problem Analysis Resolution and Ranking (PARR) - A set of tools that will assist the En Route controller in managing flight data derived from URET. PARR will assist the controller in developing strategic resolution for aircraft-to-aircraft and aircraft-to-airspace conflicts. The integration of these tools will allow the entire sector team to access the full range of tactical and strategic tools and displays at each position.
- TMA - MultiCenter (TMA-MC) - A decision support tool that builds on TMA-SC to support efficient time-based metering of arrival traffic in arrival airspace spanning multiple centers. Research will provide TMA in the complex Northeast Corridor airspace for four centers that feed Philadelphia.
- Surface Management System (SMS) - A system to reduce arrival and departure delays and inefficiencies that occur on the airport surface due to surface issues and downstream restrictions. SMS is a decision support tool that will help controllers and users of the NAS manage the movement of aircraft on the surface of busy airports, thereby improving capacity, efficiency, flexibility, and safety. SMS will support cooperative planning of other arrival and departure traffic management decision support tools to provide additional benefits.

The following R&D projects will be monitored for acceleration but are not expected to mature during the 2003-2005 timeframe:

- Expedite Departure Path (EDP) - A decision support system designed to assist controllers in TRACONs and ARTCCs with departure-related situations.
- Advanced Vortex Spacing System (AVOSS) - A completed research initiative by the National Aeronautics and Space Administration (NASA) that evaluated a ground-based system to make dynamic spacing recommendations for aircraft arriving in-trail to a runway, using current and projected atmospheric information to model wake vortex behavior. FFP2 is monitoring the work of the wake vortex research community for the possible acceleration of capacity-enhancing wake vortex-related technology.
- En Route/Descent Advisor (E/DA) - A decision support tool for the efficient handling of En Route arrivals. It will have the capability to assist controllers in handling arrival aircraft in the descent phase of the sequencing process.
- Active Final Approach Spacing Tool (aFAST) - A Terminal component of the NASA-developed CTAS that provides not only runway assignment and sequence for arriving aircraft, but also a conflict-free approach path through a series of heading and speed adjustments.

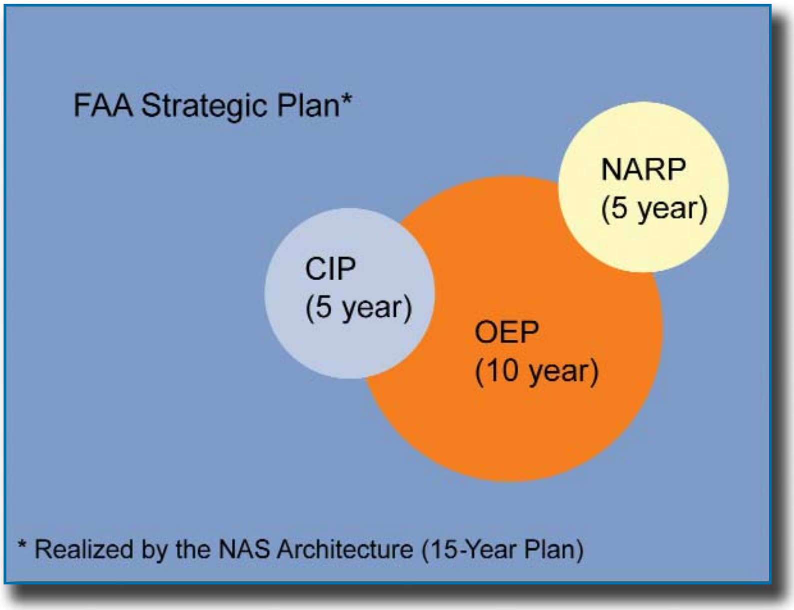
NAS-related documents

3. NAS-Related Documents

There are several plans and documents that contribute directly or indirectly to NAS modernization. Many of these documents can be found on the FAA homepage, CATS-I, or elsewhere on the Internet.

Relationship of NAS Plans

The *NAS Architecture*, the *FAA Strategic Plan*, the *NAS OEP*, the *NAS CIP*, and the *National Aviation Research Plan* (NARP) are key NAS modernization plans. Closely linked, each serves a specific purpose. The NAS Architecture is the agency's 15-year plan for modernization, supporting safety, security, and system efficiency goals. This plan establishes objectives and strategies for each goal and identifies related projects. The Architecture includes projections of all expenditures, including research, operations, F&E, and user investment. The *FAA Strategic Plan*, realized by the NAS Architecture, details FAA goals, establishes objectives and strategies for each, and identifies related projects. The OEP is the agency's commitment to the aviation industry for the next 10 years, addressing capacity and demand issues. The OEP, a subset and refinement of the Architecture, includes all expenditures, and has moved from funding projection to commitment. The CIP is the agency's 5-year F&E plan linked to FAA performance goals. The NARP describes FAA research plans, including those in partnership with other government agencies and private resources, for a 5-year period. These plans are consistent; they complement each other with increasing levels of detail relating to execution of FAA commitments. They ensure a well-planned modernization effort that balances FAA resources to maximize aviation community benefits. The graphic below summarizes the relationship of the documents.



Relationship of NAS plans

The FAA Strategic Plan

The *FAA Strategic Plan*, released in January 2001, details goals largely centered in the areas of safety, security, and system efficiency. The NAS Architecture translates Strategic Plan goals and objectives into systems and procedures needed to modernize the NAS and achieve the FAA mission.

The NAS Operational Evolution Plan (OEP)

The OEP is a 10-year plan for operational improvements to increase capacity and efficiency in U.S. air travel and transport and other use of domestic airspace. The OEP is the FAA commitment to operational improvements. It is outcome driven, with clear lines of accountability within FAA organizations. The OEP concentrates on operational solutions and integrates safety, certification, procedures, staffing, equipment, avionics, and research.

The NAS Capital Investment Plan (CIP)

The CIP aligns the NAS Architecture to the Office of Management and Budget 5-year budget planning guidance and funding. Mandated by Congress, the CIP is updated annually. The CIP defines program goals, funding, and capitalization products to sustain current services, improve safety, and expand the NAS consistent with aviation's growth.

The National Aviation Research Plan (NARP)

The NARP, a 5-year plan, provides insight into FAA research activities and their relationship to the agency's mission and goals. Current-year program descriptions and accompanying high-level schedules are grouped in the 2002 NARP according to the FAA goal structure and R&D mission support needs. The FAA R&D program finds and prepares to field technologies, systems, designs, and procedures that directly support the agency's operational and regulatory responsibilities.

Other Documents

The *System Safety Handbook* is used by FAA employees, supporting contractors, and other entities involved in applying system safety policies and procedures throughout the FAA. As the Federal agency with primary responsibility for aviation safety, the FAA develops and applies safety techniques and procedures in a wide range of activities, from NAS modernization to ATC and aircraft certification. The *System Safety Handbook* defines procedures to be used in safety analysis and development of requirements for capabilities and implementation steps defined in the NAS Architecture.

The *Aviation Capacity Enhancement Plan* is an annual review of efforts to improve the capacity of the national air transportation system by focusing on the top 100 airports, ranked by enplanements. The *Airport Capacity Benchmark Report* contains capacity benchmarks for 31 of the nation's busiest airports to help the FAA understand capacity and demand problems in order to determine cost-effective solutions and establish metrics for the OEP and air traffic performance.

In addition to NAS-wide plans, there are other plans and Web sites for specific initiatives, including Safer Skies, FFP1/FFP2, and SF-21. The *SF-21 Master Plan* details the objectives of the program and the nine enhancements addressed by the initiative. The SF-21 Web site has recent details and links to initiatives, including Capstone. The FFP1/FFP2 Web site contains detailed information relative to Free Flight initiatives. These plans and Web sites detail portions of the NAS, while the NAS Architecture covers the entire infrastructure.

Commercial aircraft

4. Partners of the FAA

The aviation community contributes to the NAS through government/industry forums, Architecture working groups, and many other arenas. The FAA and industry collaborate on R&D activities. The FAA works with partners in the aviation community to improve the NAS Architecture. This section identifies a few of the many partners working to improve the NAS.

RTCA, Inc.

RTCA, Inc. is a private, not-for-profit organization that addresses requirements and technical concepts for aviation. RTCA products include recommended standards and guidance documents that focus on the application of electronics technology to implement new or modified concepts and to satisfy related requirements.

RTCA functions as a Federal advisory organization. Its committees include the Free Flight Select Committee, the Free Flight Steering Committee, and the Program Management Committee, as well as numerous special committees.

Special committees are formed when the FAA requests that RTCA recommend Minimum Operational Performance Standards or appropriate technical guidance documents.

RTCA serves as the FAA-industry liaison, providing the FAA with vital input from industry to ensure both FAA and industry understanding of each others' direction. RTCA accepted the implementation step structure and content for the air traffic services group of the NAS Architecture, representing a general industry acceptance of the NAS Architecture approach.

International Civil Aviation Organization (ICAO)

The ICAO, a treaty organization of the United Nations, develops the principles and techniques of international air navigation and fosters the planning and development of international air transport. It includes representation from the countries in which the U.S. has significant air commerce, including our neighbors to the north and south, Canada and Mexico.

The ICAO serves many functions and shares many goals with the FAA in the international forum. The organization assists in developing and planning international air navigation. The ICAO goals include: ensuring safety in international civil aviation; encouraging the design of aircraft, airports, and navigational facilities; protecting the rights of ICAO member States; and meeting the needs of all peoples of the world for safe, regular, efficient, and economical air transport. The ICAO additionally assigns control of international airspace and has assigned 80 percent of the world's controlled Oceanic airspace to the U.S.

Research, Engineering, & Development Advisory Committee (R,E&D)

The FAA R,E&D Advisory Committee, established in 1989, advises the FAA Administrator on R&D issues and coordinates FAA R,E&D activities with industry and other government agencies. The Committee considers aviation research needs in air traffic management (ATM), airport technology, aircraft safety, aviation security, human factors, environment, and energy.

Transportation Research Board (TRB)

The Transportation Research Board (TRB) is a unit of the National Research Council, a private, not-for-profit institution that is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering. The TRB promotes innovation and progress in transportation by stimulating and conducting research, facilitating dissemination of information, and encouraging implementation of research results.

TRB tasks include: performing research and reviews of FAA concepts; identifying critical issues in transportation; assisting in identifying issues and resolving problems in safety, security, and transportation recovery; and conducting annual meetings that identify issues and concepts and help disseminate information.

National Transportation Safety Board (NTSB)

The National Transportation Safety Board (NTSB) and the FAA promote safety in aviation within their respective statutory purviews. When accidents occur, the FAA participates in the NTSB investigation to learn what accident prevention actions should be implemented and to provide technical support to the NTSB. The NTSB determines the probable cause of accidents and makes recommendations to reduce recurrences. The NTSB also assists in National Safety Summits and provides the FAA with safety recommendations.

National Aeronautics and Space Administration (NASA)

The FAA and NASA have a long history of cooperation on integrated ATM systems to enhance the capacity, efficiency, safety, and security of the NAS. Several Memoranda of Agreement allow NASA to be a full partner with the FAA in research projects. The NASA/FAA Executive Committee shares budget information, discusses metrics and goals, and explores program areas linking NASA and the FAA to ensure that R&D activities meet sponsor expectations. The FAA and NASA also cooperate on concept and decision support tool validation.

Department of Defense (DoD)

The nation's military is an important and valued user of the NAS and provides 20 percent of air traffic services. Numerous agreements exist to guide joint efforts that ensure safety and modernize the NAS. The Department of Defense (DoD) Policy Board on Federal Aviation coordinates policy changes and military representatives assigned to the FAA coordinate day-to-day activities. Also, the Space and Naval Warfare Systems Command developed and manages GPS, a critical component of future civil aviation navigation systems.

Others

There are numerous other groups and organizations that work with the FAA to achieve a safer, more efficient NAS. The FAA collaborates with civil aviation authorities around the world, sharing information relevant to current and future worldwide initiatives and with the National Weather Service (NWS) and DoD for the exchange of crucial weather information. Additionally, pilot associations and other ATC associations provide valuable input through participation in working groups and other forums. Finally, the Office of Space Commercialization works with the FAA and the International Trade Administration on space policy and distributes information concerning the global commercial space transportation market.

Commercial aircraft in flight

ATC tower

5. Flight Domains

The nation's airspace is divided into flight domains. The airspace or surface area in each domain is controlled by specific types of air traffic controllers. These controllers work in different environments, including ATC towers, TRACON facilities, and ARTCCs. Traffic is controlled on the airport surface in the **Surface domain**, during takeoff and landing in the **Terminal domain**, between destinations in the **En Route domain**, and over water in the **Oceanic domain**. The **Space domain** covers the launch, recovery, and orbit of space vehicles. Each domain presents certain challenges to the responsible air traffic controllers and support personnel. Automation, communication, surveillance, and weather systems designed to meet domain-specific challenges aid controllers in providing required services.

As an aircraft moves between ATC domains, control is carefully managed (i.e., handed off) by controllers during each phase of flight. Before takeoff, the control of an aircraft transfers from the ground controller to the local controller prior to entry on the runway. As the aircraft leaves the runway and enters the Terminal airspace, control is handed off to the radar controller responsible for that Terminal airspace. As the aircraft enters the En Route domain, control transitions to the En Route radar controller. Similarly, control transitions to the Oceanic controller if the aircraft enters Oceanic airspace. During approach and landing, a reverse set of handoffs occurs. Due to the speed of space vehicle launch and recovery, aircraft-type handoffs are not possible, so airspace is cleared for space vehicle operations through the other domains.

The ATC Flight Domains graphic below (Figure 1) summarizes the movement of an aircraft through the flight domains. The color code ( ) for each of the domains will be used in the following sections to link the air traffic service capabilities to the domains in which they are provided.

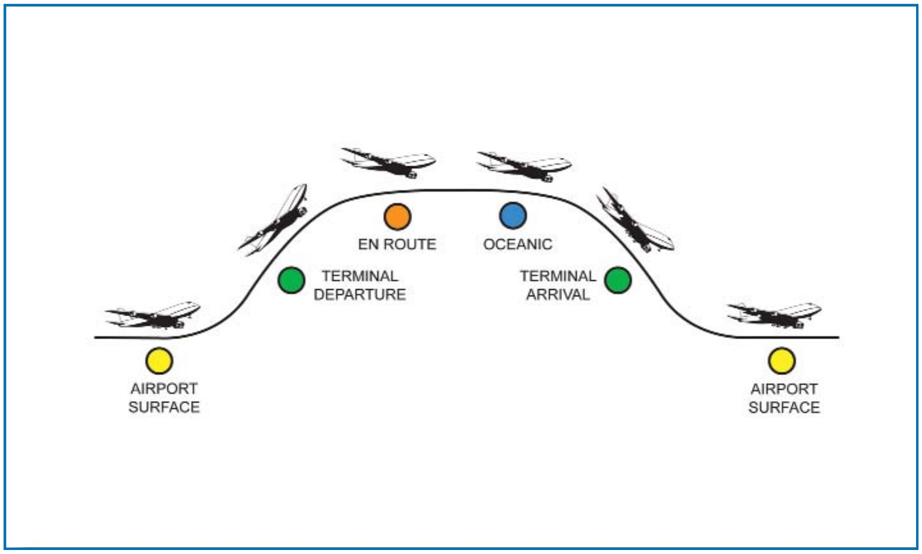


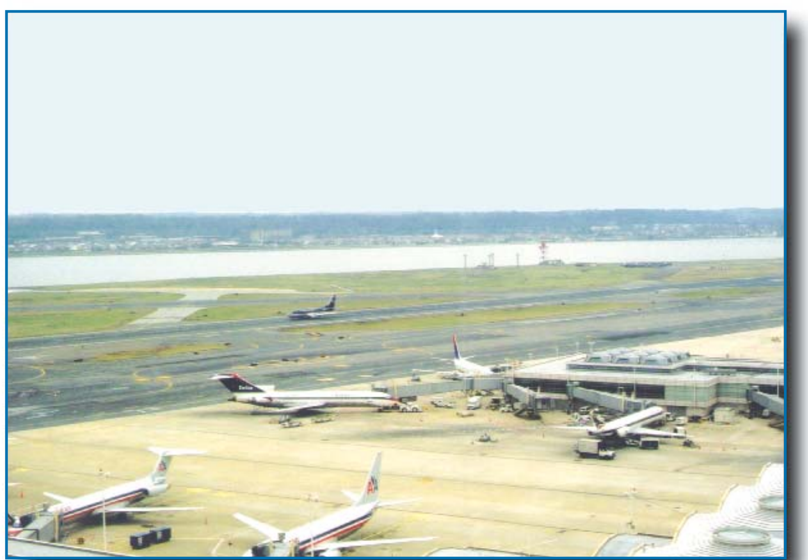
Figure 1: ATC Flight Domains

Surface

Tower controllers manage and control the airspace within about five miles of an airport. They control ground operations on airport taxiways and runways as well as departures and landings. Towers are provided with flight planning information by the En Route center. Weather information is available from airport sensors and also from the NWS via the weather processing and distribution communications network.

Aircraft and many other vehicles share the airport surface. The challenge, especially at the nation's busiest airports, is the efficient movement of this Surface traffic. Personnel who manage the movement of aircraft and other vehicles need accurate and complete information on traffic location and intentions. This is especially important at night and in low-visibility conditions. Decision support automation systems, as well as CNS systems, provide information to support ATC services and help prevent runway incursions.

The FFP1 SMA increases awareness of traffic flow into an airport, giving ramp control operators precise touchdown times. Following FFP1, SMA has been installed at 11 additional sites.



Airport surface traffic

Specialists at the involved ATC facility and air carriers will be able to improve tactical and strategic decisionmaking through the use of SMS. SMS provides accurate predictions of departure demand, queuing, and delays. SMS is being developed as part of the FFP2 priority research effort.

Tower controller at work

Airport Surface Detection Equipment - Model 3 (ASDE-3) is providing improved surface surveillance data at high activity airports. The addition of the Airport Movement Area Safety System (AMASS) provides automated alerts and warnings of potential runway incursions and other hazards to controllers, improving Surface movement safety. Thirty-seven of 38 operational ASDE-3 systems have been commissioned. The system at Ronald Reagan Washington National Airport has not yet been commissioned, as it will be relocated in late 2002. Thirteen AMASS systems have been commissioned.

Airport Surface Detection Equipment - Model X (ASDE-X) will be capable of processing radar, multilateration, and ADS-B data, which will further enhance surface surveillance data. ASDE-X will be installed at 25 airports by 2007. Also, ASDE-X technology will upgrade ASDE-3/AMASS sites with the infrastructure for multilateration and ADS-B. Eight systems are scheduled to be upgraded by 2005.

ADS-B technologies will benefit future Surface surveillance. ASDE-X systems will support ADS-B and the commercial aircraft fleet will equip with ADS-B avionics between 2007 and 2012.

The following chart (Figure 2) summarizes the transition of systems used in the Surface domain over time. Note that the dashed lines are notional timeframes used where schedule information has not yet solidified.

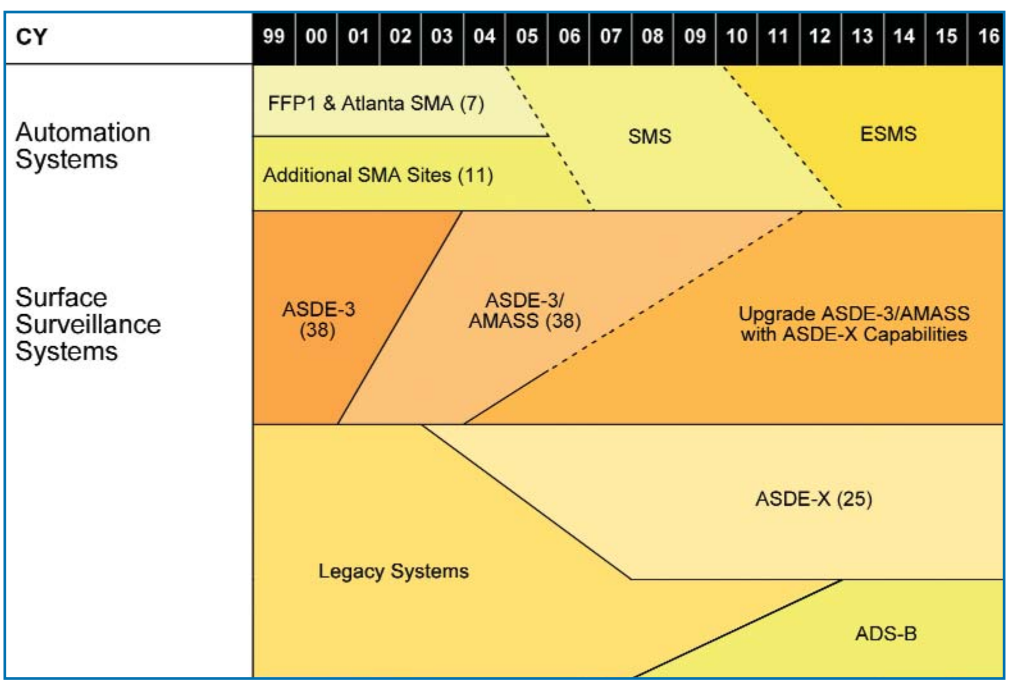


Figure 2: Surface System Transitions

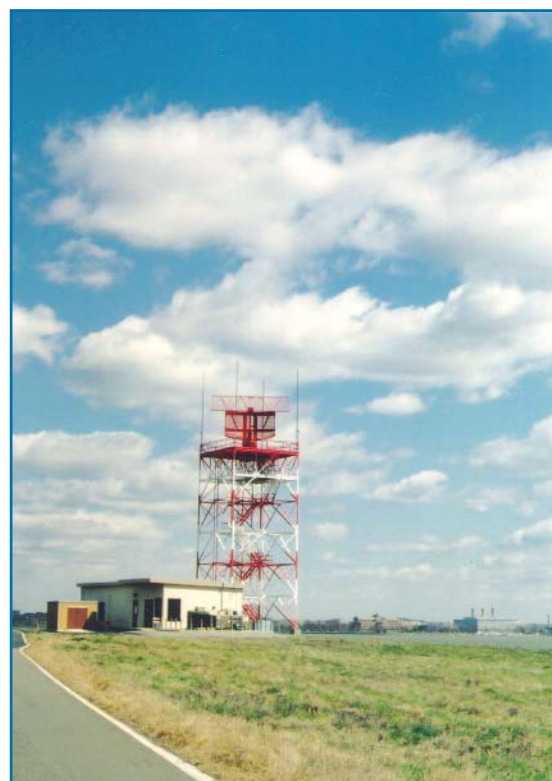
Terminal

Terminal facilities provide ATC services for airspace located within approximately 40 miles of an airport and below 10,000 feet in altitude, although larger TRACONs also control higher altitudes. Terminal controllers establish and maintain the sequence and separation of aircraft taking off, landing, or operating within the Terminal airspace. Terminal facilities are interconnected with local towers and provide surveillance and position data for aircraft under Terminal control to specialized displays within the tower.

Controllers use automation systems, CNS systems, and various types of weather information to coordinate services. New equipment and procedures are being introduced to the Terminal environment to increase capacity and improve safety.

The FAA continues TRACON consolidation activities to address system inefficiencies and realize cost savings resulting from operating and maintaining fewer facilities. One such action nears completion in Northern California. The Bay, Sacramento, Stockton, and Monterey TRACONs will be consolidated into a single facility serving Northern California Metropolitan and outlying areas. The Northern California TRACON began initial operation in August 2002 and is scheduled for full operations in August 2003.

Another consolidation in the Baltimore-Washington region, one of the top four metropolitan areas in air traffic volume, includes five airports: Baltimore-Washington International, Washington Dulles International, Ronald Reagan Washington National, Richmond International, and Andrews Air Force Base. This consolidation will enhance safety and increase traffic efficiency. The region's separate TRACON facilities will be consolidated into a single new facility, the Potomac Consolidated TRACON. The facility is scheduled to be commissioned late in 2002.



ASR-9

Additional consolidation efforts are planned, or are in progress, in Chicago, Atlanta, the Florida Sun Coast, and Central California regions.

Modern STARS equipment will replace aging ARTS equipment and aid Terminal controllers in providing separation assurance. STARS Early Display Configurations are operational at El Paso and Syracuse TRACONs.

The Airport Surveillance Radar - Model 9 (ASR-9) and Mode Select (Mode S) radars were expected to remain operational until 2005 and 2008, respectively. However, the existing infrastructure must be maintained until the transition can be made to space- or aircraft-based surveillance, utilizing GPS, Wide Area Augmentation System (WAAS), Local Area Augmentation System (LAAS), and ADS-B technologies. A Service Life Extension Program (SLEP) is planned to eliminate obsolescent parts and significantly improve the reliability and maintainability of these systems. This will result in lower maintenance costs, improved reliability, and better overall service.

ASR - Model 11 (ASR-11) will improve system efficiency and availability of service in the NAS by replacing existing ASR - Model 7/8 (ASR-7/8) systems and associated Air Traffic Control Beacon Interrogator - Model 4/5 (ATCBI-4/5) equipment. The FAA plans to commission the ASR-11 at 112 airports by 2009.

The NAS ground infrastructure to provide ADS-B air-to-ground surveillance services and ground-to-air uplink broadcast services will be deployed from 2007 to 2012. ADS-B surveillance data (i.e., call sign, position, airspeed, intent, etc.) will provide improved ATC surveillance for controllers. Air carrier fleets will achieve the intended initial ADS-B benefits in the Terminal airspace after 2012.

Terminal weather system improvements include the ASR-9 Weather Systems Processor (WSP), Integrated Terminal Weather System (ITWS), and Medium Intensity Airport Weather System (MIAWS). WSP will be commissioned at 34 ASR-9 sites by 2003. The system will improve safety by warning controllers and pilots of hazardous wind shear and microburst events near runways. ITWS installations at 34 TRACONs, serving 47 of the busiest airports, began in 2002 and will characterize the current Terminal weather situation and include a forecast of anticipated weather conditions for the next 20 minutes. MIAWS will provide a real-time display of storm positions and estimated storm track products using Next Generation Weather Radar (NEXRAD) data at Low-Level Wind Shear Alert System - Relocation/Sustainment (LLWAS-RS) sites. Thus, MIAWS will address weather information deficiencies at airports with too few flight operations to warrant a Doppler weather radar system. Tentative plans are to install MIAWS at 40 airports by 2004.

Figure 3 summarizes the transition of systems used in the Terminal domain over time. Note that the dashed lines are notional timeframes used where schedule information has not yet solidified.

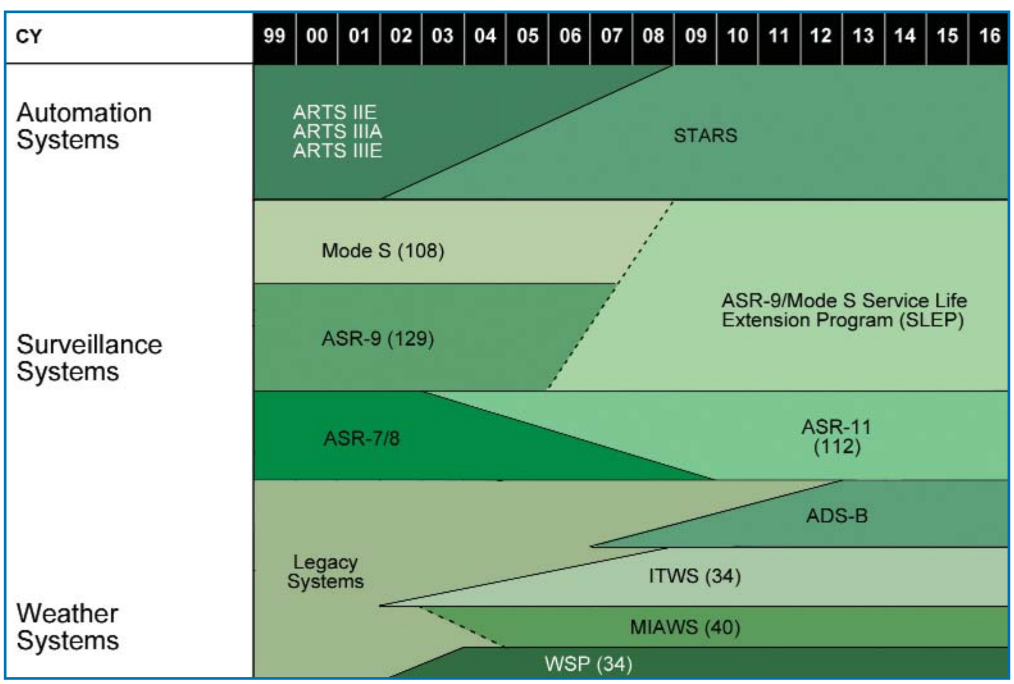


Figure 3: Terminal System Transitions

En Route

Twenty En Route centers control domestic airspace not specifically delegated to an Oceanic, Terminal, or tower control facility. Domestic airspace extends to 100 miles beyond the U.S. coast and borders with Canada and Mexico. En Route centers operate the computer suite that processes radar surveillance and flight planning data, reformats it for presentation purposes, and sends it to the Display System Replacement (DSR) equipment used by controllers to track aircraft. En Route centers control the switching of voice communications between aircraft and the center as well as between the center and other NAS facilities. En Route centers are also interconnected to the Traffic Flow Management (TFM) systems at the ATCSCC. Weather data also are processed and distributed by the En Route centers.

Many technological advances have been made in the En Route environment, several due to Free Flight initiatives that provide new automation tools in support of Free Flight concepts. Improved weather data processing and display systems provide enhanced weather data to controllers, traffic managers, and automation systems.

ARTCC automation system improvements include completion of all Host and Oceanic Computer System Replacement (HOCSR) installations at 20 ATC centers and in New York, Oakland, and Honolulu in 1999. DSR installations were completed in 2000. The En Route Automation Modernization (ERAM) program has been initiated to continue the modernization of the ARTCC automation software. ERAM will replace Host Computer Systems (HCS) and will address information security requirements. The ERAM contract award is planned for March 2003. The system will be installed in all ARTCCs by 2008.

FFP1 introduced CDM, URET, and TMA-SC. CDM provides AOCs and the FAA with real-time access to NAS status information, including weather, equipment status, and delays. FFP1 CDM was completed in 2001. FFP2 will add functionality to CDM. URET allows controllers to manage pilot requests in the En Route domain more efficiently. URET is currently operational in six ARTCCs and will be expanded in FFP2 to all ARTCCs by 2004. The TMA-SC is another FFP1 accomplishment in the En Route environment. Significant fuel savings and reduced passenger delays result from using TMA-SC. FFP1 installed TMA-SC in seven locations, while FFP2 will expand the tool to four additional sites.

> "When the industry came to us three years ago, they laid the challenge of Free Flight at our doorstep . . . we've met that challenge. URET technology works for the controller, the pilot, and the passenger."
>
> Jane F. Garvey,
> *former* Administrator
> Federal Aviation Administration

En Route surveillance has improved through installation and acceptance of 43 operational Air Route Surveillance Radar - Model 4 (ARSR-4) systems completed in May 2000.

The ATCBI - Model 6 (ATCBI-6) will replace aging ATCBI equipment (Models 4 and 5) at 124 operational sites to maintain surveillance and decrease supportability costs. Commissioning is scheduled to be complete in 2006.

The NAS ground infrastructure will be deployed from 2007 to 2012 to provide ADS-B air-to-ground surveillance services and ground-to-air uplink broadcast services. ADS-B surveillance data (i.e., call sign, position, velocity, intent, etc.) will provide improved ATC surveillance for controllers. Air carrier fleets will achieve the intended initial ADS-B benefits in the En Route airspace after 2012.

The U.S. government has determined that two additional signals are essential for certain uses of GPS. The GPS modernization program includes the addition of new L2 and L5 frequency civil signals. Additionally, an entirely new constellation of Block III GPS satellites are to be procured. These satellites will offer higher power military and civil signals, more accurate service for all users, and increased integrity.

A 21-day WAAS test was completed in 2001. Measured accuracy was 1.0 meter horizontally and 3.0 meters vertically, well within the 7.6 meter requirement. WAAS improves the accuracy and availability of GPS signals, offering a new means of navigation in the NAS. WAAS Initial Operational Capability (IOC) for safety applications is expected in 2003.

En Route weather technology advances include phased improvements to the Weather And Radar Processor (WARP) systems at all ARTCCs and the ATCSCC. These improvements include the display of mosaics from upgraded NEXRAD weather radar systems integrated with surveillance data on DSR and enhanced weather products to traffic managers and automation systems.

Figure 4 summarizes the transition of systems used in the En Route domain over time. Note that the dashed lines are notional timeframes used where schedule information has not yet solidified.

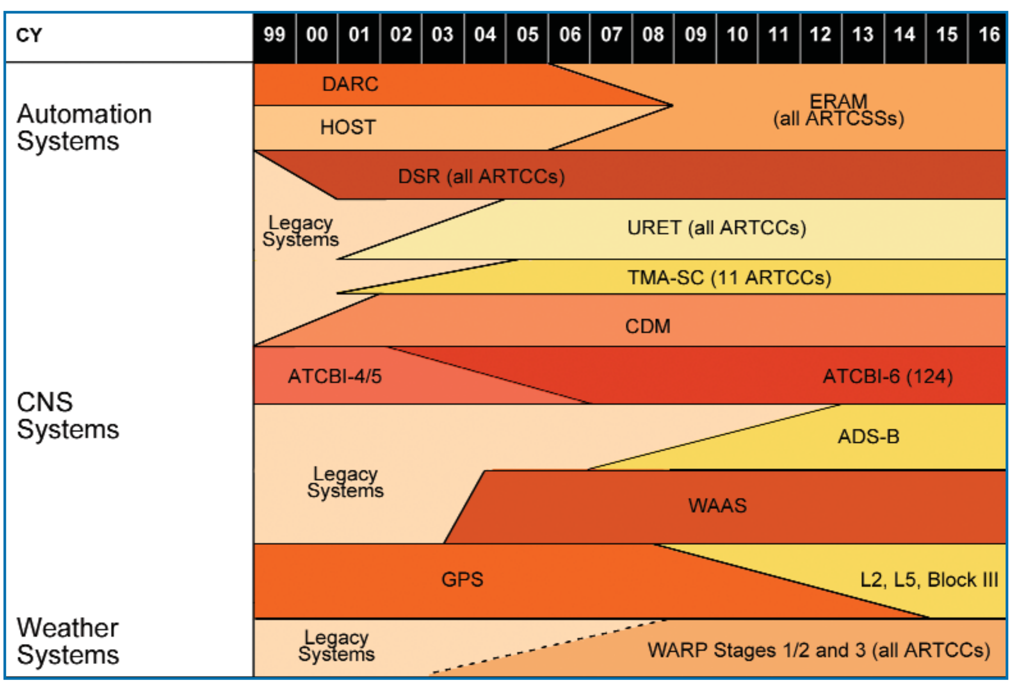


Figure 4: En Route System Transitions

Oceanic

The FAA has been allocated 80 percent of the world's controlled Oceanic airspace by the ICAO. The FAA provides ATC services for Oceanic flights within an area of approximately 3 million square miles in the Atlantic Ocean and 18 million square miles in the Pacific.

The Oceanic ATC centers control aircraft over portions of the Atlantic, Arctic, and Pacific oceans. Two Oceanic centers are co-located with En Route centers in New York and Oakland; a third is located in Anchorage. Oceanic ATC is substantially different from ATC provided over land because there are no surveillance systems to provide exact aircraft position. Position reports based on onboard aircraft navigational systems are radioed to the controller. Due to the uncertainty in position report reliability, planned overseas flight tracks must provide greater separation margins to ensure safe flight. As a result, Oceanic air traffic is rarely able to obtain maximum fuel efficiency, minimum travel times, or access to preferred flight paths.

Oceanic airspace capacity has been increased through the reduction of vertical separation standards. The Reduced Vertical Separation Minima (RVSM) concept was introduced over the North Atlantic in 1997. RVSM has been implemented on routes over the Pacific Ocean.

Advanced Technology and Oceanic Procedures (ATOP) will provide the Oceanic and offshore air traffic communities with modern automation equipment and internationally compatible ATM services. ATOP will replace the Oceanic systems in Oakland, New York, and Anchorage. The ATOP contract was awarded in June 2001. The systems are scheduled to be operational by April 2004.

Figure 5 summarizes the transition of systems used in the Oceanic domain over time.

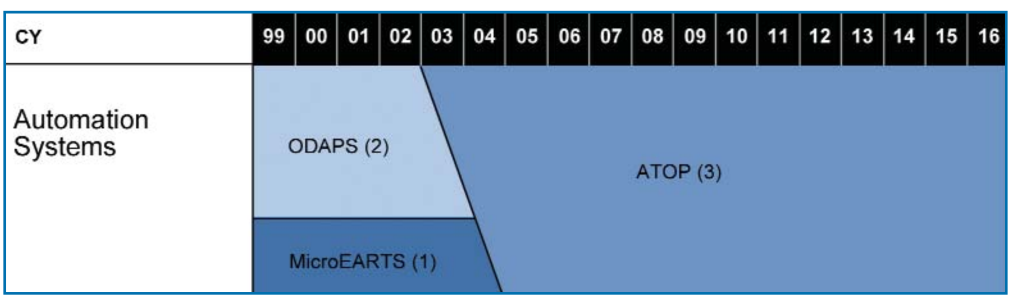


Figure 5: Oceanic System Transitions

The ATC System Command Center

6. Air Traffic Services

Air traffic services provide safe and efficient access to the NAS. Air traffic services capabilities are discussed in detail in the following sections and are summarized in Table 1: Air Traffic Services Summary. The table provides a list of the service capabilities, the applicable flight domains, and some of the enabling system and procedure highlights. The enabling systems are discussed in detail in the related air traffic services section. Additionally, where applicable, for each capability, the related OEP Solution Sets are provided to highlight the correlation between the Architecture and the OEP.

Appendix B provides the current status and the future plans for additional NAS systems. Appendix C contains location information for selected systems.

Table 1: Air Traffic Services Summary

Service	Capability	Flight Domain	Highlights
ATC Advisory	NAS Status Advisory	Surface, Terminal, En Route, Oceanic	FTI, NEXCOM, FIS-B
	Traffic Advisory	Surface, Terminal, En Route, Oceanic	TIS-B
	Weather Advisories	Surface, Terminal, En Route, Oceanic	ITWS, WARP, WSP, MIAWS, NEXRAD, FIS-B
ATC Separation Assurance	Aircraft-to-Airspace Separation	Terminal, En Route, Oceanic	STARS, CPDLC, ASR-11, ATCBI-6, ECG
	Aircraft-to-Aircraft Separation	Terminal, En Route, Oceanic	DRVSM, STARS, ATOP, ERAM, ADS-B, ADS-A, ASR-11, ATCBI-6, ECG
	Aircraft-to-Terrain Separation	Surface, Terminal, En Route	STARS, ERAM, ASR-11, ATCBI-6, ECG
	Surface Separation	Surface, Terminal	ASDE-3/AMASS, ASDE-X, ADS-B
Traffic Management Synchronization	Airborne Traffic Synchronization	Surface, Terminal, En Route, Oceanic	CTAS, URET, ATOP
	Surface Traffic Synchronization	Surface	SMA, SMS, ESMS
Navigation	Airborne Guidance	Terminal, En Route, Oceanic	WAAS, LAAS, GPS, RNAV, GBNA
	Surface Guidance	Surface	WAAS, LAAS, GPS, RIRP
Airspace Management	Airspace Design	Surface, Terminal, En Route, Oceanic	SDAT, NIRS
	Airspace for Special Use	Terminal, En Route, Oceanic	SAMS, MAMS
Emergency and Alerting	Alerting Support	Surface, Terminal, En Route, Oceanic	WAAS, GPS
	Emergency Assistance	Surface, Terminal, En Route, Oceanic	WAAS, GPS
Flight Planning	Flight Plan Processing	Surface, Terminal, En Route, Oceanic	OASIS, ATOP, ERAM
	Flight Plan Support	Pre-Flight	OASIS
Infrastructure/ Information Management	Government/ Agency Support	Surface, Terminal, En Route, Oceanic	
	Monitoring and Maintenance	Surface, Terminal, En Route, Oceanic	NIMS
	Spectrum Management	Surface, Terminal, En Route, Oceanic	NEXCOM
Traffic Management Strategic Flow	Current Performance Assessment	Surface, Terminal, En Route, Oceanic	POET, FSM
	Flight-Day Management	Surface, Terminal, En Route, Oceanic	POET, FSM, ETMS, CDM, CRCT, CCSD, CCFP, RMT, SMT, National Playbook
	Long-Term Planning	Terminal, En Route, Oceanic	POET, FSM, CDM, RMT, SMT

Air Traffic Control Advisory Services

ATC advisory services provide advice and information to assist pilots in the safe conduct of flight. The information provided to in-flight aircraft includes NAS status data as well as traffic and weather advisories.

NAS Status Advisory Capability

The NAS status advisory capability provides NAS status information for flight planning and during flight. This includes updates concerning the operational status of airspace, airports, navigational aids (navaids), in-flight or ground hazards, weather hazards, traffic management directives, and other information essential to the safety and efficiency of aircraft movement.

Modernization steps for this capability include a spectrum experiment involving two FIS providers and a demonstration of an affordable FIS for general aviation as part of the SF-21 initiative. FIS provides digital weather to the cockpit, presenting situational awareness advisories in both visual flight rules and instrument flight rules conditions. The evolution to a national FIS that will provide pilots with integrated and affordable FIS also is planned.

Aircraft cockpit

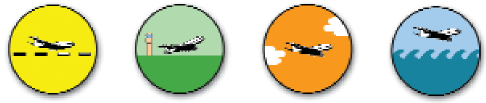
Traffic Advisory Capability

Traffic advisories are provided to alert a pilot to traffic in-flight or on the surface that may be in close proximity to the aircraft's position or route and may warrant the pilot's attention. Traffic advisories, for example, are provided to flights that are nearing other aircraft, terrain, military operations areas, hot air/gas balloons, and other potential hazards. Traffic advisories for aircraft on the surface may include the type, position, direction, and route of other ground traffic.

The modernization of this capability will include display of area traffic in the cockpit, including the broadcast of traffic information obtained from multiple types of surveillance sources.

Related OEP Solution Set
AD-7: Enhance Surface Situational Awareness

Weather Advisories Capability



Weather advisories and related information are provided to aircraft via broadcast from some facilities and upon pilot request at others. This capability includes information on hazardous weather conditions, such as thunderstorms, which pose a significant threat to aircraft.

Some highlights in the evolution of this capability include automatic simultaneous hazardous weather notification to provide the same weather information to controllers, traffic managers, airline dispatchers, and pilots. Finally, the national deployment of weather products will include dissemination in both text and graphical format to pilots en route via a service provider-maintained data link.

Related OEP Solution Sets

EW-1: Provide Better Hazardous Weather Data

AW-3: Reconfigure Airports Efficiently

Enabling Systems

The systems described below contribute to or enable the efficient delivery of the ATC advisory service.

Next Generation Air/Ground Communication System (NEXCOM)

The Next Generation Air/Ground Communication System (NEXCOM) is the FAA radio system of the 21st century. It is an analog/digital system incorporating the latest technological advances in radio communications. NEXCOM will use Very High Frequency (VHF) Digital Link - 3 (VDL-3) technology to provide additional voice and data communications channels; it also meets the demanding ICAO requirements for high reliability and low latency. NEXCOM will provide the capability to accommodate additional sectors and services; reduce logistics costs; replace outdated VHF and Ultra-High Frequency radios; provide data link communications capability; reduce Air/Ground Radio Frequency interference; and provide communication security mechanisms.

Current Status and Future Plans - In July 2001, the FAA awarded a contract to develop and produce a ground multimode digital radio. Under agreements with three vendors, the FAA will partially fund development of VDL-3 avionics. NEXCOM demonstration validation will be conducted and the NEXCOM production contract is expected to be awarded in 2005. A decision whether to authorize deployment of NEXCOM into the NAS is forecasted for 2007. If NEXCOM is implemented, over 46,000 radios will be installed throughout the NAS.

FAA Telecommunications Infrastructure (FTI)

The FAA Telecommunications Infrastructure (FTI) Program will replace the NAS interfacility and voice communications infrastructure, referred to as the NAS Interfacility Communications System (NICS), providing a virtual integrated telecommunications network infrastructure consistent with the current and future NAS Architecture. Replacement of aged FAA-owned assets and multiple FAA-managed leased service contracts will enable FTI to make state-of-the-art technology insertions required for modernization by numerous programs, while maintaining continuity with legacy systems.

FTI will provide universal access to commercial multimedia systems that meet FAA requirements for high availability, quality of service, and security at the lowest possible cost. Geographically, FTI will provide service in the Continental U.S., Alaska, Hawaii, southern Pacific, Caribbean, the Gulf of Mexico, and other international locations.

Current Status and Future Plans - The FTI contract was awarded in July 2002. The transition of services to FTI at over 5,000 FAA facilities is being planned. A phased transition of all services to FTI is scheduled to be complete by 2008.

Flight Information Service - Broadcast (FIS-B)

The FIS - Broadcast (FIS-B) will enhance pilot awareness of weather and airspace/facility status by incorporating broadcast flight information into cockpit multifunction displays. FIS products may include surface observations and warnings in a text format and graphical products. Additional aeronautical data exchange will include Notices to Airmen (NOTAM) and information about lightning, icing, turbulence, volcanic ash, and real-time Special Use Airspace (SUA).

Current Status and Future Plans - The FAA has established agreements with two companies to provide operational FIS. FIS data link is now operating in four 25 kilohertz (kHz) radio frequency channels in the 136.425-136.525 MHz VHF portion of the radio frequency spectrum. Hardware and system software packages have been certified for airborne operation. A set of core information has been approved and is being offered for sale.

Ground transmitter stations are being set up by both companies throughout the eastern U.S., and major flight routes to the west and the northwest coast are being established. As of August 2002, FIS data are being transmitted from over 90 sites in the Continental U.S. and three sites in Alaska. The plan is to complete enough stations in 2003 to enable coverage over most of the Continental U.S.

FIS-B is also being demonstrated in the SF-21 Capstone initiative. Flight information services include graphical weather depictions, as well as text-based weather and other information such as NOTAMs. FIS is being provided in Alaska via a UAT data link. Capstone UATs currently operate on 981 MHz as an interim frequency. All new UATs (Phase II equipment) will operate on 978 MHz and existing UATs will be modified to 978 MHz. As of August 2002, FIS data were being transmitted via ground-based transmitters at the following ten Alaskan sites: Aniak, Bethel, Cape Newenham, Cape Romanzof, Dillingham, King Salmon, St. Mary’s, Sparrevohn, Site Summit, and Tatalina.

FIS-B will provide for the uplink of graphical weather services to pilots equipped with UAT and a suitable cockpit display where the ground infrastructure is deployed in the 2007 to 2012 timeframe.

Traffic Information Service - Broadcast (TIS-B)

TIS-B provides area traffic information to pilots. The TIS-B processor receives surveillance data from various sources, including primary and secondary surveillance radars, ADS-B, multilateration systems, ATC automation systems, and flight plan processing systems. ADS-B ground stations will broadcast traffic information data to the aircraft cockpit display.

Current Status and Future Plans - In June 2001, the FAA SF-21/Aircraft Owners and Pilots Association demonstration system began operation of a TIS-B system in the Washington, DC area. The TIS-B service was showcased for public viewing at the Association's 2001 Annual Maryland Fly-in. TIS-B tests are scheduled for Memphis in 2003. TIS-B will provide the same situational awareness to the pilot as to the controller for airport surface operations where multilateration services exist from 2007 to 2012.

Integrated Terminal Weather System (ITWS)

ITWS will provide products to Terminal aviation system users at the busiest NAS airports that will characterize the current Terminal weather situation and include a forecast of anticipated weather conditions for the next 20 minutes, eventually extending the forecast to 2 hours by 2006. This will be achieved by integrating weather data and products from various FAA and NWS sensors (e.g., Terminal Doppler Weather Radar [TDWR], ASR-9, NEXRAD, LLWAS-Network Expansion [LLWAS-NE], and Automated Surface Observing System [ASOS]), aircraft (via the Meteorological Data Collection and Reporting System), and other NWS gridded-weather model data. Products generated by ITWS include wind shear and microburst predictions, storm cell and lightning information, and Terminal area winds aloft. ITWS will provide controllers and traffic managers with enhanced weather products enabling them to mitigate avoidable weather-induced delays and increase system capacity.

Current Status and Future Plans - Prototypes are operating in Orlando, Dallas/Fort Worth, Memphis, and in the New York City area. Implementation of ITWS production systems began with installations completed in 2002 at Kansas City International, Atlanta's Hartfield, Miami, and Houston's Bush Intercontinental, which also provides coverage for Houston Hobby Airport.

Weather And Radar Processor (WARP)

WARP provides timely weather data acquisition and dissemination to support ATC and TFM. WARP is an automated processing system that continuously acquires, stores, distributes, and displays weather information and radar products from both internal and external sources.

Stages 1 and 2 of WARP were combined and broken into two phases. Phase 1 of Stage 1/2 was the deployment of the equipment to each ARTCC and the ATCSCC. Currently underway, Phase 2 entails the development and implementation of the DSR interface to provide En Route controllers with mosaics of NEXRAD weather imagery. The mosaics, which represent data from numerous radar systems, combine NEXRAD's eight levels of precipitation intensity into three levels for FAA air traffic controller use. WARP Stage 3 upgrades further enhance weather support to NAS operations with cost-effective sharing of weather products to NAS service providers, users, and automation systems. Implemented in 2002, a WARP sub-system called Weather Information Network Server (WINS) facilitates "common situational awareness" among operational decisionmakers of weather impacts on En Route NAS operations. Also, these upgrades enable WARP to use improved input weather model and sensor data, yielding improved weather products.

Current Status and Future Plans - WARP Stage 1/2 Phase 1 systems are operational at all ARTCCs and the ATCSCC. These systems replaced portions of the leased, vendor-provided WARP Stage 0 and enable WARP to receive NEXRAD radar data directly. Stage 1/2 Phase 2 is scheduled to be complete late in 2002. The Fort Worth center became the first facility with operational NEXRAD mosaics on DSR in May 2002. Some of WARP Stage 3 was implemented early at seven ARTCCs in 2001 to support FFP1. Stage 3 activities continue to develop crucial NAS interfaces to other NAS systems (e.g., ITWS, Operational and

Supportability Implementation System [OASIS], and Enhanced Traffic Management System [ETMS]).

Weather Systems Processor (WSP)

WSP is a modification enhancement to the ASR-9 Terminal surveillance radar, enabling it to process data from the six-level weather channel. The mission of the WSP is to improve safety by warning Terminal controllers and pilots of hazardous wind shear and microburst events near runways. The system also will be used to predict the arrival of gust fronts and to track storm motion, giving a complete picture of current and future Terminal area hazardous weather conditions that may impact runway usage. WSP is intended for medium air-traffic density airports with high wind shear exposure not covered by TDWR. The system improves Terminal area flight safety.

Weather satellite photo of Continental U.S.

Current Status and Future Plans - System deployment began in 2001. Deployment and commissioning of all 34 operational systems is scheduled to be complete in early 2003. WSP enhances the ASR-9 radar system that will be undergoing a SLEP in the 2005 to 2008 timeframe.

Medium Intensity Airport Weather System (MIAWS)

MIAWS will provide Terminal controllers with a real-time display of storm positions and estimated storm track products from NEXRAD data at LLWAS-RS sites to address weather information deficiencies at airports with too few flight operations to warrant a Doppler weather radar system. Using WSP display technology, MIAWS will not only display six levels of precipitation intensity, but will also alert tower controllers when moderate or severe weather threatens airport operations.

Current Status and Future Plans - MIAWS prototypes are located in Jackson, MS and Memphis, TN. Two additional prototypes were added in Little Rock, AR and Springfield, MO in the summer of 2002. During prototype development, the feasibility of relaying MIAWS products to the cockpit via Terminal Weather Information for Pilots (TWIP) and to airline dispatchers will be determined. Tentative plans are to install MIAWS at 40 LLWAS-RS sites.

Next Generation Weather Radar (NEXRAD)

NEXRAD provides a national network of Doppler weather radar systems to detect, process, and distribute hazardous and routine weather information for use by the DOT, DOC, and DoD.

Current Status and Future Plans - There are 164 NEXRAD systems. Each agency shares operating/maintenance costs, including algorithm development, to improve system performance and provide new products. The 12 systems owned by the FAA are located in Alaska (7), Hawaii (4), and Puerto Rico (1).

NEXRAD open-systems product improvements will enhance network capacity, and will incorporate algorithms enabling shorter refresh rate times and advanced methods of detecting weather hazards.

ATC Separation Assurance Service

The separation assurance service ensures that aircraft maintain a safe distance from other aircraft, terrain, obstacles, and certain airspace not designated for routine air travel. Separation assurance involves applying separation standards to ensure safety. New automation systems, including STARS, ATOP, and ERAM, will improve these services. Additionally, GPS and ADS-B technologies offer improved surveillance data used in the delivery of this service.

Aircraft-to-Airspace Separation Capability

Aircraft are separated from SUA, such as prohibited, restricted, and warning areas. The SUA is designed to ensure safety for unique aircraft operations or to prohibit flight within a specified area. Separation standards ensure that aircraft remain at an appropriate distance from the SUA.

The FAA began development of the Falcon View automation system in January 2001 to provide an automated platform to coordinate SUA information between DoD and FAA. The testing and operational procedures will be complete by October 2002.

Aircraft-to-Aircraft Separation Capability

The aircraft-to-aircraft separation assurance capability ensures that aircraft maintain a safe distance from other aircraft and vehicles. Separation standards are employed to ensure safety and are defined for aircraft operating in different environments.

Evolution in this area includes efforts to reduce current aircraft separation standards that will increase the NAS capacity while maintaining safety. The objective of Domestic RVSM (DRVSM) is to implement RVSM in the vertical strata of the airspace of the contiguous 48 States and Alaska, and in Gulf of Mexico airspace where the FAA provides air traffic services (Houston and Miami Oceanic Flight Information Regions and Jacksonville Offshore Airspace).

Related OEP Solution Sets

AD-1: Runway Additions Allow Improved Airport Configurations
AD-2: Use Crossing Runway Procedures
ER-3: Reduce Voice Communication
ER-4: Reduce Vertical Separation
ER-5: Reduce Offshore Separation
ER-6: Reduce Oceanic Separation

Surveillance sources, including ADS, will be integrated to provide more accurate position and intent data. Additionally, data link technologies will increase the efficiency of controller and pilot routine message exchange.

Aircraft-to-Terrain Separation Capability

The NAS employs defined separation standards to prevent aircraft collision with terrain or obstacles. Methods include publishing safety zones and processing position and intent information. This area will evolve to provide low-cost terrain avoidance information to pilots.

Surface Separation Capability

Air traffic controllers in the tower provide separation assurance between aircraft, aircraft and vehicles, and aircraft and obstructions on runways. Pilots use “see-and-avoid” procedures on taxiways and follow instructions provided by air traffic controllers.

Common situational awareness and surveillance data fusion will lead to improvements in surface separation. ADS-B will provide accurate position reports for equipped aircraft. Multilateration will provide position reports for all aircraft and vehicles having tagged beacon transmitters. ADS-B and multilateration position reporting will be combined with ASDE primary radar in ASDE-X, resulting in improved surveillance data.

Related OEP Solution Sets

- AD-6: Coordinate for Efficient Surface Movement
- AD-7: Enhance Surface Situational Awareness
- AW-2: Space Closer to Visual Standards

Enabling Systems

The systems described below contribute to or enable the efficient delivery of the ATC separation assurance service.

Standard Terminal Automation Replacement System (STARS)

STARS is a modern TRACON automation system that processes primary and secondary radar information to acquire and track aircraft position for display to controllers. STARS incorporates safety tools including conflict alert, Mode C intruder, final monitoring aid, minimum safe altitude warning, converging runway display aid, and controller automated spacing aid. STARS will also offer improved radar processing, GPS compatibility, adaptive routing, link implementation, improved weather display, and better utilization of traffic management information.

Current Status and Future Plans - STARS Early Display Configurations are operational at El Paso and Syracuse TRACONs. See the STARS Home Page for additional information.

Controller-Pilot Data Link Communications (CPDLC)

CPDLC provides for the digital transmission and reception of messages between pilots and controllers. The implementation of CPDLC is a joint effort between the Federal government and industry. Capabilities are being phased incrementally into ATC operations. Achieving benefits from CPDLC depends on both the government developing the required ground infrastructure and aircraft operators voluntarily equipping with and using CPDLC.

Current Status and Future Plans - Controllers have been trained at the Miami ARTCC for a Build I operational evaluation scheduled for 2002. This evaluation will use the following four message service types: transfer of communications, initial contact, altimeter setting, and menu text.

Build IA will expand the message set to include the following controller-initiated uplink services: altitude assignment, speed assignment, heading assignment, crossing restrictions, and route clearance, as well as a capability to handle pilot-initiated altitude requests. Build IA initial daily use is planned for December 2005, which will be followed by national deployment.

Airport Surveillance Radar - Model 11 (ASR-11)

The ASR-11 is a short-range radar system with a 60 nautical mile (nmi) detection range for medium and small activity airports. The ASR-11 provides advanced digital primary radar including weather intensity surveillance with an integrated, monopulse, secondary surveillance radar system for use in the TRACON area.

The ASR-11 will improve system efficiency and availability of service in the NAS by replacing existing ASR-7/8 systems and associated ATCBI-4/5.

Current Status and Future Plans - Twenty-nine ASR-11 sites have been selected, environmental activities at 17 sites have been completed, and construction has begun at 5 sites. Systems are being procured via a joint DoD/FAA development contract. A total of 116 systems, including 2 mobile and 2 support, will be commissioned by 2009.

Air Traffic Control Beacon Interrogator - Model 6 (ATCBI-6)

The ATCBI-6 is a ground-based system that interrogates transponders, receives and processes replies from transponders, determines the range and azimuth to the aircraft, and forwards the information to appropriate ATC automation systems. Replies provide transponder identification and altitude data. The ATCBI-6 will replace aging ATCBI equipment (Models 4 and 5) to maintain ground surveillance and decrease supportability costs.

Current Status and Future Plans - The ATCBI-6 production decision was made in July 2000. The first commissioning was at the key site, Tinker Air Force Base, in July 2002. The final system, in Yakutat, AK, will be commissioned in 2006. Current plans are for the procurement of 124 operational and 3 support systems.

Advanced Technologies and Oceanic Procedures (ATOP)

ATOP will provide the Oceanic and offshore air traffic communities with internationally compatible ATM services. ATOP will replace the Oceanic systems at the Anchorage, New York, and Oakland centers, which handle air traffic in international airspace over the Pacific and Atlantic oceans. ATOP will collect, manage, and display Oceanic air traffic data, including electronic flight strip data on the computer displays used by air traffic controllers, and integrate capabilities such as flight data processing, radar data processing, and ADS.

Current Status and Future Plans - ATOP Build I is being installed in Oakland in 2002 and is on track for IOC in April 2003. New York Build I IOC is scheduled for December 2003. Build II for Anchorage is scheduled for IOC in April 2004.

En Route Automation Modernization (ERAM)

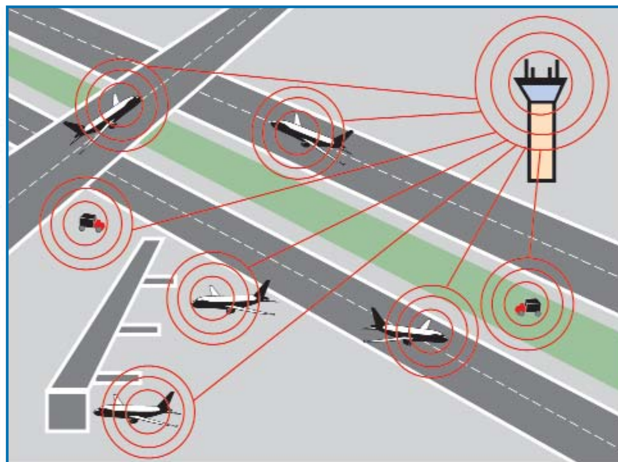
ERAM replaces the current primary En Route automation systems (HCS and Direct Access Radar Channel [DARC], respectively) and the Local Area Network (LAN)-based infrastructure Host Interface Device (HID) NAS LAN (HNL). The HCS hardware will reach end of service life in 2008, and the next generation hardware will no longer support the legacy operating system for which the NAS software was designed in 1970. Similarly, HNL will reach end of service life in 2003. ERAM will replace current HCS and DARC hardware and NAS software. The new NAS software will be consistent with NAS Architecture and provide a new Flight Data Processor (FDP) for processing ICAO flight plans and a new Surveillance Data Processor (SDP) for processing ADS-B. ERAM will replace the HNL with new industry standard infrastructure and interfaces.

Replacement of HCS and DARC will be accompanied by replacement of the current Monitor and Control (M&C) system as well. The new M&C will be extensible, capable of being used by other En Route systems, and will be a step towards realizing an Integrated M&C for the En Route domain.

Current Status and Future Plans - The ERAM contract award is planned for March 2003. The system will be installed in all ARTCCs by 2008.

Airport Movement Area Safety System/Airport Surface Detection Equipment - Model 3 (AMASS/ASDE-3)

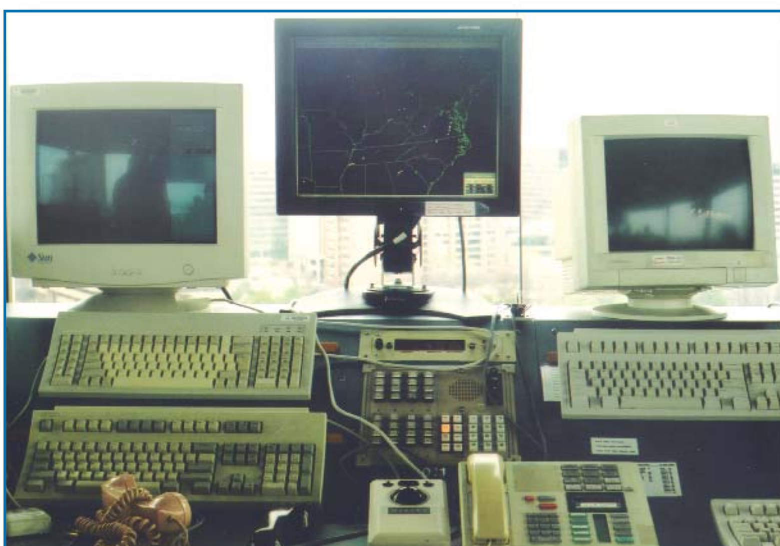
AMASS is an add-on enhancement to the host ASDE-3 radar. ASDE-3 provides radar surveillance of aircraft and airport surface vehicles at high activity airports. AMASS/ASDE-3 provides automated alerts and warnings of potential runway incursions and other hazards to controllers, improving surface movement safety. AMASS interfaces with existing ASR-9 and ARTS automation equipment.



Many systems aid tower controllers in managing surface traffic

Current Status and Future Plans - All 37 operational AMASS units have been delivered. Thirteen AMASS systems are commissioned, another six are in operational use. The last operational readiness demonstration is scheduled for September 2003 in Houston.

Airport Surface Detection Equipment - Model X (ASDE-X)



Tower displays

ASDE-X is a modular surface surveillance system capable of processing radar, multilateration, and ADS-B sensor data. The system provides seamless airport surface surveillance to air traffic controllers. ASDE-X will be deployed at airports that are not covered by ASDE-3/AMASS. The ASDE-X system depicts aircraft vehicle position and identification information overlaid on a color map showing the surface movement area and arrival corridors.

Current Status and Future Plans - ASDE-X is scheduled to be installed at 25 airports. Additionally, ASDE-X technology is scheduled to be added to selected ASDE-3/AMASS locations. ASDE-X will support ADS-B and TIS-B as commercial aircraft equip with ADS-B in the 2007 to 2012 timeframe.

Automatic Dependent Surveillance - Addressable (ADS-A)

ADS - Addressable (ADS-A) enables equipped aircraft to provide periodic position reports automatically via data link. ADS-A avionics are devices that, upon reception of messages specifically addressed to the aircraft, compose and transmit a response message specifically addressed to the interrogator. The message contains the current position of the aircraft as determined by onboard navigation equipment, the aircraft identification, and short-term planned course changes. The primary use of ADS-A is in Oceanic areas.

Current Status and Future Plans - The Oceanic Data Link system is installed at the Oakland, New York, and Anchorage centers.

Automatic Dependent Surveillance - Broadcast (ADS-B)

ADS-B technology provides for the broadcast of information via digital data link between a source and multiple destinations. Aircraft equipped with ADS-B avionics broadcast their position as determined by onboard navigation avionics. This will be a precise location for aircraft equipped with GPS (or GPS/WAAS) avionics, or a less accurate position if derived from ground-based navaids or the aircraft's inertial navigation sensors. Other data, including airspeed, altitude, and planned course changes, may also be transmitted. Receivers on the ground, as well as ADS-B avionics aboard other aircraft, receive this broadcast information. The information can then be processed and displayed to the controller or the pilot, providing a picture of area traffic.

Current Status and Future Plans - Phase I of the Capstone program initiated daily use of ADS-B technology to track and service traffic in areas with no radar coverage. Over 160 aircraft are equipped with ADS-B avionics, and 10 ground stations are operational. Phase I of the Capstone program will extend through December 31, 2004. The second phase of Capstone is about to begin in the Juneau area. Up to 200 aircraft, both fixed-wing and rotary, will be equipped with the Phase II avionics.

The FAA, responding to U.S. aviation industry requests received via the Free Flight Steering Committee, announced in July 2002 the architecture selected for ADS-B. The FAA, having completed the evaluation of the alternative ADS-B technologies, selected an ADS-B architecture that utilizes a combination of the 1090 MHz Extended Squitter ADS-B link for air carrier and private/commercial operators of high-performance airframes, and the UAT ADS-B link for typical GA users.

The ground infrastructure will be deployed from 2007 to 2012 to provide ADS-B air-to-ground surveillance services and ground-to-air uplink broadcast services over 1090 MHz Extended Squitter and UAT. Over the same time period, the commercial aircraft fleet will complete ADS-B equipage. Air carrier fleets will achieve the intended initial ADS-B benefits in the Terminal and En Route airspace in the post-2012 timeframe.

Domestic Reduced Vertical Separation Minima (DRVSM)

NAS capacity can be increased by reducing separation standards, thus allowing more aircraft in a volume of airspace. RVSM reduces the vertical separation above flight level (FL) 290 from the current 2,000-ft minimum to a 1,000-ft minimum. This increases airspace capacity and allows aircraft to fly optimal profiles and save fuel. Increased altimetry accuracy is needed at and above FL290 to permit separation less than the current standard.

> "By allowing aircraft greater flexibility to fly at different altitudes, airlines and general aviation alike can save time and reduce their costs while we improve the safety and efficiency of the system. It's a win-win situation for all sectors of the aviation community."
>
> Norman Y. Mineta,
> Secretary
> U.S. Department of Transportation

Current Status and Future Plans - RVSM was first introduced over the North Atlantic in 1997. Since then, RVSM has been implemented on routes over the Pacific Ocean and Australia. In early 2002, RVSM was introduced over Continental Europe and the South China Sea.

Plans are being made to introduce DRVSM. The FAA published a Notice of Proposed Rulemaking in the *Federal Register* on RVSM on May 10, 2002, which announced the FAA intention to implement DRVSM in December 2004. By then, the agency estimates, greater than 90 percent of flights between 29,000 and 41,000 feet will be made by RVSM-compliant aircraft.

En Route Communications Gateway (ECG)

The En Route Communications Gateway (ECG) will be deployed in a phased development/implementation. ECG Phase 1 will replace the existing Peripheral Adapter Module Replacement Item (PAMRI), which is reaching the end of its service life. PAMRI provides the interface between the Host and the DARC and nearly all external interfaces. The PAMRI basic function is to take incoming information from many narrow bandwidth telecommunications lines and multiplex them into wider bandwidth channels. The inverse function is performed with respect to outbound information. These interfaces include all of the radars, external flight data input (Flight Service Stations, Flight Data Input/Outputs [FDIOs], Direct User Access Terminals [DUATs]), adjacent ARTCC and TRACON automation systems, DoD base operations, North American Aerospace Defense Command (NORAD), and Customs Service, among others. PAMRI also provides an intra-ARTCC high-speed parallel interface to local ETMS, the National Airspace Data Interchange Network (NADIN) concentrator and limited flight data transfer between the Host and the DARC.

Subsequent Phases of ECG will be deployed to overcome PAMRI limitations to meet the needs of En Route modernization. Many of the planned applications for the future En Route automation needs comprise newer and different local and remote interfaces. The existing PAMRI is limited to the existing interfaces with their antiquated physical layer connectivity, transmission media, communications protocols, speeds, and information content. This applies not only to the external inputs (surveillance sensors, inter-facility interfaces with adjacent En Route and Terminal automation systems, FDIO, and the military), but also to the major local systems: the existing Host and DARC and the ERAM system.

The subsequent phases of ECG will support simultaneously the existing interfaces and the new interfaces. Most importantly, it will support a lengthy transition period where both old and new interfaces will be accommodated until each system (local and remote) is upgraded and operational confidence and proven reliability is demonstrated for each interface. The existing PAMRI will not meet the quantity and type of interfaces required to support this transition. The ECG will support this transition and is necessary for ERAM improvements.

Current Status and Future Plans - ECG was approved and baselined by the Joint Resources Council on March 13, 2002. ECG is to be deployed at 20 ARTCCs, the William J. Hughes Technical Center, and the FAA Academy by the end of 2005.

Traffic Management Synchronization Service

Traffic synchronization supports expeditious flight for aircraft simultaneously using the NAS. NAS processes operate to maximize efficiency and capacity in response to weather, NAS infrastructure changes in status, runway availability, and other conditions. Traffic synchronization is the tactical portion of traffic management that provides sequencing, spacing, and routing of both airborne and surface aircraft. Traffic synchronization activities are accomplished while maintaining separation standards and implementing strategic flow management directives.

Airborne Traffic Synchronization Capability

Related OEP Solution Sets

AD-1: Runway Additions Allow Improved Airport Configurations
AD-4: Fill Gaps in Arrival and Departure Streams
AW-2: Space Closer to Visual Standards
ER-7: Accommodate User Preferred Routing

Airborne synchronization, or the spacing and sequencing of air traffic, safely maximizes the efficiency and capacity of the NAS throughout the departure, cruise, and arrival phases of flight. Maximum efficiency, predictability, and capacity are obtained by applying processes that reduce variability in achieving coordinated separation standards.

URET and TMA-SC help airborne traffic synchronization. Both tools will be deployed to additional locations in FFP2. Future evolution includes enhanced conflict probe and conflict resolution capabilities.

Surface Traffic Synchronization Capability

Related OEP Solution Set

AD-6: Coordinate for Efficient Surface Movement

Controllers, airline ramp coordinators, and pilots use procedural, visual, and automated means to provide surface synchronization. For example, controllers issue taxi clearances and instructions to provide optimal and predictable flows of traffic by communicating with pilots and vehicle operators on the surface.

New tools for airport surface traffic management will enable airport personnel to predict, plan, and advise surface aircraft movements. Animated airport surface displays for all vehicles on the ground will display real-time information to all parties of interest, supplementing available visual information. Additionally, improved decisionmaking capabilities for air traffic controllers will more effectively balance runway loads.

Enabling Systems

The systems described below contribute to, or enable, the efficient delivery of traffic management synchronization services. In addition to these systems, ATOP, used in the ATC separation assurance service, contributes to traffic management synchronization services.

User Request Evaluation Tool (URET)

URET is a conflict probe tool that enables controllers to manage user requests in En Route airspace by identifying potential aircraft-to-aircraft conflicts up to 20 minutes in the future. It also checks for and alerts controllers to conflicts between routes and SUA boundaries.

Current Status and Future Plans - Controllers at the Kansas City ARTCC began operational use of URET in December 2001. URET was implemented at the Memphis, Indianapolis, Cleveland, Chicago, and Washington centers in early 2002. URET receives gridded wind and temperature data from WARP WINS to optimize its performance. URET continues to produce user benefits through increased direct routings and reductions in static altitude restrictions. URET is scheduled to be installed in all En Route centers by 2004 under FFP2.

Traffic Management Advisor - Single Center (TMA-SC)

TMA-SC helps to optimize traffic flow in the extended airspace around an airport. It enables En Route controllers and traffic management specialists to develop complete arrival scheduling plans ("meter lists") of properly separated aircraft. These plans then support early runway assignments to maximize airport use of available capacity. TMA helps controllers optimize traffic flow into adapted airports and efficiently use available runways and surrounding airspace. Displays depict aircraft approaching runways and airspace in a timeline. Controllers can observe potential imbalances and use the data to suggest optimal solutions.

Current Status and Future Plans - Use of TMA-SC at the Fort Worth Center shows that it can increase the arrival rate into Dallas/Fort Worth International Airport by five percent. FFP2 will deploy TMA-SC to the Houston, Kansas City, Indianapolis, and Memphis centers.

Surface Movement Advisor (SMA)

SMA shares information with airline and airport personnel who plan and manage the flow of traffic on airline ramps. SMA provides current aircraft arrival information to ramp operators and managers. This information sharing improves efficiency by optimizing gate operations and ground support services while reducing taxi time and hold delays. SMA provides transitional capabilities that will ultimately be incorporated in the SMS.

Current Status and Future Plans - Under FFP1, SMA systems are operational in Chicago, Dallas/Fort Worth, Detroit, Teterboro, Newark, and Philadelphia. Success of the SMA system has led to FFP2 SMS development. SMA has also been deployed to additional TRACONs, including the North Georgia Large TRACON, New York, Philadelphia, Detroit, Gateway, Dallas/Fort Worth, Boston, Charlotte, Pittsburgh, Minneapolis, and Chicago TRACONs.

Surface Management System (SMS)

SMS is a decision support tool that will help controllers and users of the NAS manage the movement of aircraft on the surface of busy airports, thereby improving capacity, efficiency, flexibility, and safety. SMS will support cooperative planning of other arrival and departure traffic management decision support tools to provide additional benefits.

Current Status and Future Plans - SMS is being developed as part of FFP2 priority research. An SMS demonstration is planned for Memphis in 2003.

Enhanced Surface Management System (ESMS)

Enhanced SMS (ESMS) will enable users and providers to have access to flight planning, traffic management, arrival/departure, and weather information, giving a complete picture of airport operations. Using a perimeter “look-ahead” feature, the enhanced multifunctional displays will show conflict predictions between arriving aircraft and surface aircraft/vehicles. The goal is to have all airport operations, including ATC, aircraft, airline and AOCs, ramp control, and airport emergency centers, receiving and exchanging common surface movement data.

Current Status and Future Plans - ESMS is in concept development. The system architecture will be developed in the 2005 to 2008 timeframe following the deployment of ASDE-X and the Memphis demonstration.

Navigation Service

The navigation service provides guidance to allow NAS users with suitable avionics to operate their aircraft safely and efficiently under different weather conditions. The service includes both ground- and space-based networks of navaids for the NAS. These navaids broadcast electromagnetic signals in accordance with international standards. The navigation service provides guidance during airborne operations (i.e., cruise, approach, and landing) and during surface operations.

Airborne Guidance Capability

Related OEP Solution Sets

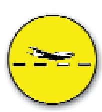
AD-1: Runway Additions Allow Improved Airport Configurations

AW-1: Maintain Runway Use in Reduced Visibility

The NAS provides signals in space through space-based mechanisms and ground-based systems for point-in-space navigation through a variety of operating environments. These environments include structured routes, random routings, and transitions.

Future plans include introducing systems to improve the accuracy of GPS position data for navigation and precision approaches.

Surface Guidance Capability



Airport surface guidance aids aircraft on the airport surface by providing taxiway and runway lighting; signage; markings; and obstacle identification.

Future enhancements include implementing lighting and signage emerging from R&D programs.

Enabling Systems

The systems described below contribute to or enable the efficient delivery of navigation services.

Global Positioning System (GPS)

GPS is a space-based radio-navigation system. It consists of ground monitoring and control stations and 24 satellites orbiting Earth at an altitude of approximately 11,000 miles. GPS provides users with accurate information on position, velocity, and time anywhere in the world and in all weather conditions.

GPS provides two levels of service: a Standard Positioning Service (SPS), which uses the L1 frequency (1575.42 MHz); and a Precise Positioning Service (PPS), which uses both the L1 and L2 (1227.60 MHz) frequencies. Access to the PPS is restricted to U.S. Armed Forces, U.S. Federal agencies, and selected allied armed forces and governments. These restrictions are based on national security considerations. The SPS is available to all users on a continuous, worldwide basis, free of any direct user charge.

The current NAS ground-based navigation system is costly to maintain and precludes many users from accruing the benefits of direct point-to-point navigation, optimum routing, and other capacity enhancing applications. The FAA has committed to approving GPS for civil aviation. However, at the present time, the requisite accuracy, integrity, availability, and continuity of the SPS must be augmented for GPS to be used in En Route and Terminal domains and for nonprecision and precision approaches. The FAA has initiated the WAAS and LAAS programs, described below, to provide such augmentation.

Current Status and Future Plans - GPS is fully operational. The DoD maintains a 24-satellite constellation, launching replacement satellites based on anticipated need.

The U.S. government has determined that two additional signals are essential for certain uses of GPS. A second civil signal will be added at the GPS L2 frequency. This signal will enable dual-frequency receivers to correct for ionospheric errors. The DoD plans to launch the first satellite with this new capability (Block IIR-M) in 2003. IOC (18 satellites in orbit) is planned for 2008 and full operational capability (FOC) with 24 satellites in orbit is planned for 2010.

A third civil signal to meet the needs of critical safety-of-life applications such as civil aviation will be added at 1176.45 MHz and is designated as L5. L5 can serve as a redundant signal to the GPS L1 frequency in order to ensure continuity of service to provide precision approach capability for aviation users. At least one satellite (Block IIF) is planned to be operational with the new L5 capability no later than 2005, with IOC planned for 2012 and FOC planned for 2014.

The GPS modernization program, besides adding the new L2 and L5 civil signals, will also procure an entirely new constellation of Block III GPS satellites. The Block III satellites will offer higher power military and civil signals, more accurate service for all users, and increased integrity. GPS III has the potential to meet a broad array of civil and military needs via GPS alone (i.e., without need for augmentation). Aviation applications are a key driver of Block III requirements. The first GPS III satellite is expected to be launched in 2009.

Wide Area Augmentation System (WAAS)

The FAA is developing WAAS to augment GPS for aviation users. WAAS provides a signal-in-space, broadcast from Geostationary Earth Orbit (GEO) satellites, to enable users to navigate En Route through precision approach phases of flight. The signal provides differential corrections of GPS and GEO satellites to improve ranging accuracy; availability and continuity; and data integrity. System coverage eventually will include the Continental U.S., Hawaii, Puerto Rico, and Alaska (except for the Alaskan peninsula west of 160° W longitude or outside of the GEO broadcast area).

Current Status and Future Plans - WAAS continuously broadcasts differential corrections and is available for non-safety applications. WAAS IOC for safety applications, expected in 2003, will support En Route navigation, nonprecision approach, and approach with Lateral Navigation/Vertical Navigation operations. After achieving IOC, WAAS will be incrementally improved to expand the area of coverage, increase the availability of nonprecision approaches and Area Navigation (RNAV), increase signal redundancy, reduce operational restrictions, and support precision approach operations. WAAS will ultimately incorporate the new GPS civil signal at L5 to provide a more robust and interference-resistant service to those users who equip with dual-frequency avionics. This expanded capability will support all phases of flight in the NAS except Category (CAT) II and III precision approaches.

Local Area Augmentation System (LAAS)

LAAS augments GPS by focusing navigation service in the airport area (approximately a 20-30 mile radius). LAAS broadcasts its correction message via a VHF radio data link from a ground-based transmitter. The system will yield the extremely high accuracy, availability, and integrity necessary for CAT I, II, and III precision approach applications. CAT I LAAS is being developed through government/ industry partnerships.

Current Status and Future Plans - Prototype CAT I LAAS units are installed and under evaluation at several sites, including Chicago's O'Hare and Midway, Memphis, Cedar Rapids, Minneapolis, Moses Lake Airfield in Washington, and Salt Lake City. An additional unit will be installed at New Century Airport in Kansas.

The FAA expects to award a contract for the production of CAT I LAAS systems in late 2002, with the first production systems delivered in 2004 and commissioned for public use in 2005. Technical studies, research, and specification development for CAT II/III LAAS are expected to continue through 2004. An investment decision will then determine whether to proceed with a contract for full-scale development and production of CAT II/III systems.

Ground-Based Navigational Aids (GBNA)

Navigation services are currently provided by unaugmented GPS and by a network of Ground-Based Navigational Aids (GBNA). VHF Omnidirectional Range (VOR) and Distance Measuring Equipment (DME) systems, and to a limited extent, the Loran-C system, support En Route navigation Aeronautical Nondirectional Beacons (NDB) support En Route navigation in Alaska and along limited Eastern coastal areas. The VOR and NDBs also support nonprecision approach operations at thousands of airports throughout the NAS. Tactical Air Navigation (TACAN) systems provide similar support to military users. CAT I, II, and III precision approach operations are supported primarily by the Instrument Landing System (ILS) equipment installed at hundreds of airports.

Current Status and Future Plans - Navigation service will continue to be provided by the legacy GBNA throughout and after transition to the augmented satellite-based services provided by GPS, WAAS, and LAAS. The FAA is working with the user community to determine the types and numbers of GBNA to retain to provide a level of redundant navigation service. Initial indications are that the FAA will sustain a full network of DME and TACAN, and a reduced network of VOR, NDB, and ILS. Loran-C's future is less certain and may depend on its value to other modes of transportation and as a timing reference system.

Area Navigation (RNAV)

RNAV is the application of the navigation process that provides the capability to establish and maintain a flight path on any chosen course that remains within the coverage area of navigation sources being used. Current Terminal airspace operations consist largely of controllers vectoring aircraft, which often causes large variations in the flight times of aircraft in the Terminal area. These variations can lead to extended flying paths, costing additional time and fuel, as well as reduced schedule predictability, resulting in passenger delays and disrupted flight schedules. Aircraft that are Flight Management System/RNAV-equipped can navigate precisely point-to-point, without flying directly over ground-based navaids. The introduction of RNAV routes throughout the NAS will result in reduced air/ground communications, improved schedule predictability, reduced flying time, potential fuel savings, and improved situational awareness for controllers and pilots.

Current Status and Future Plans - Many commercial aircraft already have an RNAV capability. The anticipated equipage with GPS avionics (including WAAS and LAAS) will make RNAV ubiquitous across the NAS. A recent example of a National Airspace Redesign (NAR) implementation of RNAV routes occurred in Las Vegas. In October 2001, the Las Vegas TRACON and Los Angeles Center implemented the Four Cornerpost Project (4CP); becoming the first major airport to use RNAV arrival and departure procedures for all runways, bringing an estimated combined savings of over $45 million in the first 12 months.

Runway Incursion Reduction Program (RIRP)

A runway incursion is any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in loss of separation with an aircraft taking off, intending to take off, landing, or intending to land. Runway incursions may result from pilot deviations, operational errors, vehicle or pedestrian deviations, or operational deviations.

One of the FAA key safety initiatives is the reduction of runway incursions. The FAA is working with the aviation community to identify various educational programs and technological advances which will reduce incursions.

The FAA has instituted a Runway Incursion Reduction Program (RIRP) to increase the safety of aircraft and vehicle movement and decrease the potential for accidents on the airport surface. This program will explore, evaluate, and validate current and emerging technologies that show potential to increase runway safety in the NAS. Evaluation projects are assessing the technical and operational suitability of new concepts in surface traffic surveillance as well as pilot and controller situational awareness tools. Technologies under evaluation include:

- Inductive Loop Sensors - a non-radar based system for detecting surface vehicle movement;
- Multilateration and multisensor data fusion for the Surface domain; and
- Multisensor-driven Runway Status Lights - an automated system to provide aircrews real-time runway activity status alerts.

Airspace Management Service

The airspace management service ensures the proper and safe use of the national airspace. This includes the design, allocation, and stewardship of the airspace. Maximum safety and efficiency in using airspace result from coordinating airspace user needs and available capacity. Effective airspace management requires integration of airspace design and management of SUA.

The national airspace is a critical and limited resource. While aircraft, ATC systems, and technology in general have advanced significantly, the structure of the airspace has not changed appreciably in the past few decades.

In July 1998, the FAA began the first coordinated, comprehensive effort to redesign national airspace with the NAR project. With the evolution of operations and modernization of supporting systems, the FAA recognized the need to develop a consistent, cohesive approach for airspace redesign that would meet local and national objectives. The NAR is a systematic approach to increasing the efficiency and capacity of the NAS. Beginning with the New York/New Jersey Airspace Redesign, this effort is now implementing projects in the Great Lakes, Central, and Western Pacific Regions. The FAA recently completed evaluation periods for two major NAR projects, the New York flip-flop and the Las Vegas 4CP.

In New York, as part of the NAS Choke Points initiative, the FAA reversed, or “flip-flopped,” routes for flights inbound to the New York LaGuardia and Newark Airports. The Choke Point program is a near-term NAR airspace improvement initiative that focuses on the creation of new procedures and changes to U.S. airspace in order to gain greater efficiency. The flip-flopped routes, at Yardley, PA and Robbinsville, NJ, are two points at which air traffic controllers align aircraft for approach to Newark and LaGuardia airports when they arrive from the south. ATC specialists at the New York TRACON now have greater flexibility to merge and sequence Newark arrivals.

The Las Vegas 4CP Phase I began in October 2001 and has performed well. The Las Vegas TRACON and Los Angeles Center worked together to make McCarran International Airport the first major airport to use RNAV arrival and departure procedures for all runways. Las Vegas has just begun implementing Phase II of the 4CP. The Las Vegas TRACON and Los Angeles Center will be adjusting and testing a variety of new RNAV routes to ensure arrivals and departures have an even smoother transition into and out of the terminal area.

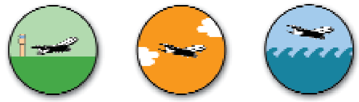
Airspace Design Capability

Airspace design provides maximum use of this national resource while ensuring safety. Airspace planning and analysis considers, among other elements, existing design, current and projected traffic usage, radio frequency congestion, effects of airport construction, proposed and existing surface structures, and environmental factors such as noise abatement.

Evolution toward controllers' ability to reconfigure airspace in real or near-real time, a capability referred to as dynamic resectorization, will occur.

Related OEP Solution Sets
AD-1: Runway Additions Allow Improved Airport Configurations
AD-3: Redesign Terminal Airspace and Routes
AD-5: Expand Use of 3-Mile Separation Standard
ER-1: Match Airspace Design to Demands
ER-2: Collaborate to Manage Congestion
ER-5: Reduce Offshore Separation

Airspace for Special Use Capability



Related OEP Solution Set
ER-8: Improve Access to Special Use Airspace

SUA includes prohibited, restricted, and warning areas. Airspace for special use supports the national defense mission, fosters development of commercial space enterprises, protects sensitive areas, and ensures protection of natural resources.

The FAA is working with the military concerning several pieces of SUA and obtaining more real-time access. Each of these efforts is pursued with the military on a case-by-case basis. The Buckeye Military Operations Area working group has been established to facilitate the process.

Enabling Systems

The systems described below contribute to or enable the efficient delivery of the airspace management service.

Sector Design Analysis Tool (SDAT)

The Sector Design Analysis Tool (SDAT) is an analytic tool that evaluates changes in airspace design and traffic routing. SDAT is a component of the SDAT Enterprise, an FAA-owned decision support tool for analysis and design of airspace and traffic flows. Its primary focus is supporting the activities undertaken by FAA airspace offices at local, regional, and national levels. SDAT applications include airspace visualization, traffic flow analysis, and model integration. The SDAT Enterprise tool suite currently consists of three components: SDAT, the high-end visualization and analysis tool; SDAT Construct, for data and project management; and AT Vista, an ATC display emulator.

Current Status and Future Plans - SDAT has been in use for several years and has recently become a component of SDAT Enterprise.

Noise Integrated Routing System (NIRS)

The Noise Integrated Routing System (NIRS) is a noise-assessment program designed to provide analyses of air traffic changes over broad areas. It works in conjunction with other air traffic modeling systems that provide the source of routes, events, and air traffic procedures such as altitude restrictions.

Current Status and Future Plans - NIRS software is available and will run with various operating systems on multiple platforms.

Special Use Airspace Management System (SAMS)

The SUA Management System (SAMS) is an automated system that supports integrated SUA schedule operations both within the FAA and between the FAA and the DoD. The SAMS processor receives airspace schedule messages from the Military Airspace Management System (MAMS).

Current Status and Future Plans - The SAMS processor is located at the ATCSCC; SAMS workstations are located at the ATCSCC, ARTCCs, towers, TRACONs, and Center Radar Approach Control facilities.

Military Airspace Management System (MAMS)

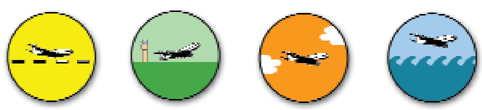
MAMS is an automated system that schedules and documents SUA and other related airspace utilization for the DoD. It receives airspace schedule messages from local DoD airspace scheduling agencies and transmits airspace schedule messages to SAMS.

Current Status and Future Plans - The MAMS central facility is located at Tinker Air Force Base, OK.

Emergency and Alerting Service

The emergency and alerting service monitors the NAS for distress or urgent situations, evaluates the nature of the situation, and provides an appropriate response. This service covers situations that occur on the ground or in-flight.

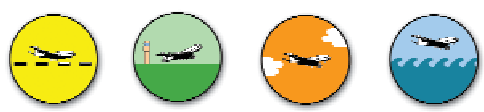
Alerting Support Capability



When an aircraft is overdue or missing, a communications search is initiated to determine when the aircraft last contacted an ATC facility.

Future improvements in this area include using satellite-based ADS-B technologies to provide controllers and search and rescue personnel with aircraft location information and discrete aircraft identification of downed or distressed aircraft.

Emergency Assistance Capability



Emergency assistance ranges from assisting aircraft low on fuel or aircraft involved in a hijacking to alerting rescue coordination agencies that an aircraft is overdue or missing.

There is currently no formal evolution planned for this capability. However, emergency assistance will benefit from most future NAS system improvements.

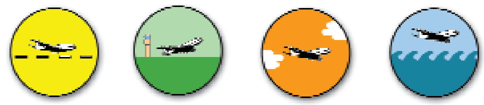
Enabling Systems

GPS and WAAS, also used in the navigation service, contribute to emergency and alerting services.

Flight Planning Service

The flight planning service supports the efficient use of the nation's airspace by developing and using coordinated flight plans. This includes preparing and conducting preflight and in-flight briefings, filing flight plans and amendments, managing flight plan acceptance and evaluation, preparing flight planning broadcast messages, and maintaining flight planning data archives. This service includes preparing initial flight plans and allowing changes to flight profiles while operating within the NAS.

Flight Plan Processing Capability



Flight plan processing provides acceptance and processing of flight plan data from all users (e.g., GA, commercial, military, and law enforcement), validates the flight plans, notifies users of any problems, and processes amendments, cancellations, and flight plan closures.

Evolution in flight plan processing includes plans to provide interactive feedback to NAS users on proposed flight plans based on current constraints. In the more distant future, the concept of flight objects and 4-Dimensional (4-D) trajectories will be introduced.

Flight Plan Support Capability

Flight plan support provides NAS users essential weather and aeronautical information. Flight planning requires information such as expected route, altitude, time of flight, available navigation systems, available routes, SUA restrictions, daily demand conditions, and anticipated flight conditions, including weather, sky conditions, and advisories (e.g., volcanic ash, smoke, and birds). Future plans for this capability include the automatic notification of SUA status to pilots.

Enabling Systems

OASIS contributes to or enables the efficient delivery of the flight planning service. In addition, ATOP and ERAM, used in the ATC separation assurance service, contribute to flight planning.

Operational and Supportability Implementation System (OASIS)

OASIS provides alphanumeric and graphic weather product acquisition and display, flight plan processing, NOTAMs, search and rescue services, administrative and supervisory capabilities, flight planning and regulatory information, and system maintenance functions. OASIS will enhance the safety and efficiency of the NAS by providing a single integrated solution for improved weather products, a modern graphical user interface, simultaneous display of weather graphics and alphanumeric flight route information, and integrated training capabilities. OASIS system hardware and software are provided to the FAA as a service and will be operated by flight service specialists 24 hours a day, 7 days a week.

Current Status and Future Plans - OASIS is operating at the Seattle Automated Flight Service Station (AFSS). OASIS will be installed throughout the U.S., including Alaska, Hawaii, and Puerto Rico. When fully deployed in 2006, OASIS will be installed at 61 AFSS sites. Three additional support systems will be available: two located at the FAA William J. Hughes Technical Center in Atlantic City and one at the FAA Mike Monroney Aeronautical Center in Oklahoma City.

Infrastructure/Information Management Service

Infrastructure/information management ensures NAS utility through infrastructure management and operation and optimal use of resources. Infrastructure resources include systems such as radar, communication links, navaids and automation, while information management includes NAS monitoring and maintenance.

Government/Agency Support Capability

Government/agency support provides and coordinates information. The NAS supports DoD operations, law enforcement missions, government land management agencies, firefighting operations, and State aviation managers.

No formal evolution is planned for this capability. However, recent events have made the coordination between government agencies even more critical. The FAA will contribute to this increased coordination.

Monitoring and Maintenance Capability

Monitoring and maintenance includes the activities necessary to monitor NAS status, detect and isolate failures and outages, and perform corrective and preventive maintenance to ensure NAS operational readiness.

Evolution of this capability will increase operational readiness through better management of maintenance resources using remote monitoring of equipment status and interactive diagnostic, corrective, and preventive maintenance.

Spectrum Management Capability

Spectrum management concerns securing, protecting, and managing the radio spectrum for the FAA and the U.S. aviation community. The available spectrum is limited and in great demand. The aviation community is one of the major U.S. users of the radio frequency spectrum. In fact, the top three spectrum users in the Federal government are the FAA, the Air Force, and the Navy; the FAA has over 50,000 frequency assignments. Virtually all FAA CNS systems are dependent on use of the radio frequency spectrum. Numerous aircraft systems, including airborne weather radar, are users of the spectrum.

International spectrum usage is governed by the International Telecommunication Union (ITU), an agency sponsored by the United Nations. The ICAO is the primary entity for establishing international civil aviation standards for worldwide system interoperability. The FAA represents the U.S. in both the ITU and the ICAO. The FAA will continue to work with both the ITU and the ICAO to ensure the efficient use of spectrum worldwide.

Enabling Systems

NAS Infrastructure Management System (NIMS) contributes to or enables the efficient delivery of the infrastructure/information services. Additionally, NEXCOM, used in the ATC advisory service, will contribute to infrastructure/information services.

NAS Infrastructure Management System (NIMS)

NIMS provides automated operations support for new centralized National/Operations Control Centers (NOCC/OCC) and field specialists. This new approach to the operation and maintenance of the NAS infrastructure incorporates a performance-based service management approach that will achieve user and customer satisfaction and manage NAS infrastructure services. NIMS is based on the use of COTS products to provide the functionality required. NIMS will allow remote monitoring and control of both legacy and new NAS subsystems using industry standard management interfaces and protocols. Management of resources such as spares, test equipment, specialists, logging of equipment/services outages, and recording maintenance activities will also be provided.

NIMS functions include equipment monitoring, control, event management, fault management, performance management, workforce management, resource management, operational configuration management, report logging, archiving, and generation, security management, and support functions.

Current Status and Future Plans - In May 2000, the FAA approved the funding for NIMS Phase 2 for 2001-2005. In 2001, IOC for the NOCC/OCCs was achieved and seven General NAS Maintenance Control Centers were consolidated into OCCs.

NIMS Phase 2 will focus on fully implementing resource management with cost and performance metrics. NIMS functionality will be deployed to 33 service operations centers and more than 300 work centers.

Traffic Management Strategic Flow Service

The strategic flow service provides for orderly flow of air traffic from a NAS perspective. NAS capacity and demand is analyzed and balanced to minimize delays, avoid congestion, and maximize throughput, flexibility, and predictability. Actual and predicted demand are compared to current and predicted capacity of the airspace, airports, and infrastructure to plan overall NAS strategy.

When necessary, TFM plans are developed collaboratively to optimize the flow of traffic while accommodating user requests and schedules, airspace, infrastructure, weather constraints, and other variables. The strategic flow service comprises current performance assessment, flight-day management (current 24-hour period), and long-term planning (more than 1 day in advance).

Current Performance Assessment Capability

Performance assessment provides institutional memory, without loss due to retiring employees or replacing equipment, by archiving information to support post-flight analyses of NAS traffic flow.

The performance assessment capability will continue to improve with the evolution of existing tools, such as Post Operations Evaluation Tool (POET).

Flight-Day Management Capability

Flight-day management optimizes NAS traffic flow for the current 24-hour period.

This capability will continue to improve with the evolution of existing decision-support tools and introduction of new tools to increase flexibility to manage flight operations under constraints (e.g., SUA, equipment and facility status, and weather conditions).

Related OEP Solution Sets

AD-3: Redesign Terminal Airspace and Routes
AD-6: Coordinate for Efficient Surface Movement
AW-3: Reconfigure Airports Efficiently
ER-2: Collaborate to Manage Congestion
EW-1: Provide Better Hazardous Weather Data

Long-Term Planning Capability

The long-term planning capability predicts capacity and demand more than one day in advance and validates capacity and demand models. Tools such as POET and Flight Schedule Monitor (FSM) are used to support long-term planning.

Evolution is toward strategic adjustments to personnel assignments, resulting in a better match of sectorization and staffing to anticipated flows.

Enabling Systems

The systems described below contribute to or enable the efficient delivery of traffic management strategic flow services.

Post Operations Evaluation Tool (POET)

POET is an analysis system used by the ATCSCC, ARTCCs, other FAA facilities, and NAS users to identify and analyze ATC system-wide problems. POET allows users to explore NAS functions, using a variety of performance metrics, including departure, En Route, and arrival delays, and filed-versus-actually-flown flight tracks.

Current Status and Future Plans - The POET server is installed at the ATCSCC and has access to archived ETMS data. These data are updated daily and the server maintains a “rolling” 45-day data set spanning the NAS for ready analysis by POET. Users can easily access, filter, and visualize the flight information contained in the ETMS data archive using a variety of interactive charts, tables, and geographic displays. POET has a built-in collection of powerful data-mining tools to assist the user in recognizing data patterns and trends. Access by CDM airlines to Near Real-Time POET was completed on March 5, 2002. The next phase of POET development will involve connectivity through the Internet for non-FAA users.

Flight Schedule Monitor (FSM)

FSM allows FAA and airline CDM users to monitor and manage airport demand and capacity. The ATCSCC uses FSM to coordinate Ground Stop and Ground Delay Program (GDP) strategies when capacity/demand imbalances occur.

Current Status and Future Plans - FSM is used by more than 30 FAA facilities and 30 airlines in the U.S. and Canada. FSM is available as freeware to any system operator (e.g., airlines and GA) who signs a Memorandum of Agreement with the FAA. Future enhancements will include distance-based GDPs, multi-fix GDPs, and multiple-airport GDPs.

Enhanced Traffic Management System (ETMS)

ETMS is an existing computer system used to track, predict, and plan air traffic flow, as well as to analyze ground delay effects and to evaluate alternative routing strategies. ETMS is the heart of the TFM-Infrastructure. ETMS helps coordinators respond strategically to situations across the NAS rather than focus on only local solutions. This broader viewpoint reduces NAS-wide delays and annually saves millions of dollars in aviation fuel costs.

Current Status and Future Plans - The DOT Volpe National Transportation Systems Center operates the ETMS hubsite 24 hours per day, 7 days a week. Enhancements are introduced with periodic software releases.

Collaborative Decision Making (CDM)

CDM provides AOCs and the FAA with real-time access to NAS status information, including weather, equipment availability, and delays. This information sharing enables collaboration between the FAA and the airlines, which leads to more efficient airspace management. The initial three components of CDM are GDP Enhancements, Initial Collaborative Routing, and NAS Status Information.

Current Status and Future Plans - Over 30 airlines and NAV CANADA are currently enrolled as users of the system. The Strategic Planning Teleconference (SPT) was initiated in 2000 to improve system predictability. The SPT is a collaborative effort where participants actively seek the most advantageous mitigation to an airport/airspace constriction in the NAS. The ATCSCC sets the agenda and coordinates these teleconferences with participation from personnel from FAA field facilities and the airlines. This collaboration allows both the FAA and users to plan and execute daily flight operations. FFP2 will deploy CDM with CRCT functionality on the TFM-Infrastructure to 20 ARTCCs and the ATCSCC.

FFP2 CDM initiatives include Enhanced Data Exchange (formerly NAS Status Information), Enhanced Arrival and Departure Management (formerly Ground Delay Program Enhancements), Congestion Management (formerly Initial Collaborative Routing), Performance Assessment, and Impact Assessment.

The NAS-wide Information System will provide an exchange of electronic data and increase collaboration between NAS users and service providers. With this increased exchange of information, carriers will be able to adjust their schedules to maximize safety and efficiency, since flight data, including the filed flight profile and amendments, and up-to-date flight schedules, will be readily available to NAS users. The FAA will also make airlines aware when equipment needs to be serviced so the airlines can change schedules to increase efficiency.

Collaborative Routing Coordination Tools (CRCT)

CRCT is a concept development prototype system that evaluates and identifies a limited set of critical functions, including: designating airspace with severe weather or congestion as a Flow Constrained Area (FCA); identifying all flights predicted to enter the FCA; creating and assessing the impact of rerouting strategies; and facilitating collaborative routing decisions for efficient and safe use of the NAS.

Current Status and Future Plans - Prototype CRCTs have been installed for evaluation purposes in Kansas City, Indianapolis, and the ATCSCC. CRCT will be further developed with CDM in FFP2. Methods of processing weather data to optimize performance will be investigated.

Common Constraint Situation Display (CCSD)

The Common Constraint Situation Display (CCSD) is a new traffic management capability to be provided through a Web browser that will share CRCT functionality information with AOCs. The CCSD will be able to share FCA and impacted flights and sector overlay and loading information based on monitor alert data. Future releases will include Collaborative Convective Forecast Product (CCFP).

Current Status and Future Plans - The CCSD can be accessed via the ATCSCC Web site and CDMnet. A new version of the CCSD, delivered in early 2002, provides additional constraint management information (CCSD now displays public reroutes) and incorporates CCFP.

Collaborative Convective Forecast Product (CCFP)

CCFP is a process that begins with an initial convective weather forecast for the next 2–6 hours being produced every 4 hours by the Aviation Weather Center in Kansas City. This forecast then evolves into a final product through collaboration by participating meteorologists at the airlines, various Center Weather Service Units, and the Aviation Weather Center.

Current Status and Future Plans - The CCFP is now available in the Traffic Situation Display (TSD), the main ETMS user interface. Improved convective products will be implemented on ETMS in May 2003.

Route Management Tool (RMT)

The Route Management Tool (RMT) offers a national routes database updated in 56-day intervals that facilitates the timely dissemination and implementation of reroutes. RMT manages the Coded Departure Route (CDR) database (severe weather routes). CDRs are used to reduce coordination time during severe weather or departure congestion events and to standardize route coordination for users.

Current Status and Future Plans - RMT was initially deployed in April 2000, and can be accessed via the CDMnet or via the ATCSCC Web site. Future RMT versions may include Miles-In-Trail monitoring, National Playbook database management, and CCFP display capability.

Sector Management Tool (SMT)

The Sector Management Tool (SMT) is a prototype ETMS feature that helps traffic managers develop "what-if" solutions to predict sector traffic-loading problems by assigning ground delays. It calculates the minute-by-minute traffic load in a sector and then applies a smoothing method to reduce projected traffic to the capacity threshold.

Current Status and Future Plans - Traffic managers at selected ARTCCs and the ATCSCC are evaluating SMT to determine its operational suitability. Deployment of SMT will be based on the results of the overall operational suitability assessment.

National Playbook

The National Playbook is one of several initiatives underway to improve NAS performance using CDM. The National Playbook is a collection of Severe Weather Avoidance Plan routes that are pre-validated and coordinated with impacted ARTCCs. It is designed to mitigate potential adverse impacts to users and the FAA during periods of severe weather or other events that affect the NAS.

Current Status and Future Plans - The National Playbook is in place and is coordinated by the ATCSCC.

Other NAS services

7. Other NAS Services

The NAS Architecture addresses several other NAS service groups in addition to Air Traffic. These include Safety, Certification, Airport Management, Security, and FAA Business Management.

Safety

Aviation system safety will continue to be the top priority throughout NAS modernization as capacity, efficiency, and flexibility increase. Safety will be enhanced through:

- Incrementally implementing new systems while legacy systems continue operation;
- Applying safety principles as new technology is introduced; and
- Considering and incorporating human performance in advanced automation technology.

> "Strengthening our commitment to keeping safety as our paramount concern cannot be overemphasized."
>
> Norman Y. Mineta, Secretary
> U.S. Department of Transportation

Many FAA initiatives focus on increasing NAS safety. As part of the *FAA Strategic Plan*, the Safety Mission Goal is to reduce U.S. aviation fatal accident rates by 80 percent from 1996 levels by 2007. Goals are set to reduce GA accidents (which include nonfatal accidents) to 350 per year, reduce the overall aircraft accident rate per 100,000 flight hours, and increase survivability.

In 1998, the FAA announced a major initiative to achieve significant reductions in fatal accidents by 2007. Concentrating resources on the most prevalent causes of aircraft accidents, Safer Skies is an initiative that uses a disciplined, data-driven approach to find root causes and determine the best actions to break the chain of events leading to accidents.

The Safer Skies focused approach encompasses:

- Analyzing past accidents;
- Identifying accident precursors;
- Developing specific interventions to address precursors;
- Implementing the interventions;
- Tracking implementation for effectiveness; and
- Using knowledge gained to improve the aviation system.

Safer Skies consists of three teams with similar goals to improve aviation safety.

- The Commercial Aviation Safety Team (CAST) aims to reduce the commercial aviation accident rate by 80 percent by 2007. CAST, originally founded as an industry initiative, comprises representatives from government and industry. CAST is now part of the commercial aviation portion of the FAA Safer Skies agenda. CAST focuses on the leading causes of commercial aviation fatalities, including uncontained engine failures, Controlled Flight Into Terrain (CFIT), approach and landing, loss of control, runway incursions, and weather.
- The General Aviation Joint Steering Committee aims to eliminate the equivalent of an entire year's worth of accidents by 2007. This committee focuses on the leading causes of GA accidents, including CFIT, weather, pilot decisionmaking, loss of control, and runway incursions, and on increasing survivability.
- The Partners in Cabin Safety Team has completed work in several areas, including child restraints, passenger seatbelt use, carry-on baggage, and unruly passengers, thus accomplishing the cabin safety portion of the Safer Skies initiative in 2000.

Other FAA safety strategies include safety risk mitigation and information sharing. Safety risk mitigation leads to the development and fielding of systems, technologies, and procedures that target high-risk hazards in the NAS, and the development of an integrated safety risk management process that ensures hazards are identified, assessed, and managed to reduce risk. The FAA is acquiring proven, often leading-edge technologies designed to reduce risk associated with the highest safety hazards in the NAS. The FAA has programs that work to prevent runway incursions, mid-air collisions, flight-into-hazardous-weather conditions, and CFIT. Systems supporting safety risk mitigation include: GPS, WAAS, LAAS, ADS-B, ASDE-X, ASDE-3, AMASS, TDWR, NEXRAD, ITWS, and MIAWS.

For safety information sharing, the FAA develops partnerships with the aviation community to share data and information supporting safe, secure aviation. The purpose is to identify potential problems and issues before they lead to accidents and to route information to appropriate personnel. One project that supports this strategy is the Aviation Safety Action Program (ASAP).

The ASAP partnership, which includes the FAA, airlines, and employee unions, encourages better reporting of safety concerns by aviation employees to their employers. ASAP gives the FAA and airlines an important new source of information to prevent unsafe incidents and will help meet the goal of reducing commercial aviation accidents by 80 percent by 2007.

Certification

The FAA regulates aerospace safety. The numerous activities involved in carrying out this mission include:

- Certification of aircraft and aircraft components, air operators and airmen, NAS ground-based equipment, airspace changes, and airports; continued airworthiness monitoring and inspection of aircraft; and new or revised flight regulations that change operating procedures;
- Issuance of licenses to conduct commercial space transportation launches and re-entry flights and to operate non-Federal launch and re-entry sites; and
- Participation in accident investigation and rulemaking activities.

The transition to new technologies and systems creates a challenge to certify and maintain certification of substantial NAS equipment. Equipment introduced into the NAS must be certified prior to operational use. Timely and comprehensive certification of avionics, software, and equipment is essential to NAS modernization. Certification standards involve close collaboration with the aviation industry. In addition, new regulations are required to address new capabilities, such as direct routing, that will result from NAS modernization.

The FAA strategy for aerospace safety regulation is to extend traditional regulatory and enforcement roles to develop new approaches to working with the aerospace community on certification, inspection, and surveillance. The FAA targets resources with the greatest possible positive impact on aerospace safety. Projects supporting aerospace safety regulation include the Air Transportation Oversight System (ATOS), Space Transportation Vehicle Safety, and development of national safety standards for commercial launch operations.

ATOS is an improved way of doing business for the FAA. The goal is to foster a higher level of air carrier safety using a systematic, data-driven approach to identify safety trends and prevent accidents.

Air carriers must operate at the highest level of safety and FAA inspectors ensure that they comply with Federal regulations. ATOS ensures that air carriers have safety built into their operations and changes the way the FAA manages air carrier safety. ATOS is a proactive approach that goes beyond ensuring compliance with regulations. The FAA asks its workforce to think in terms of system safety and risk management, rather than simply to comply with regulations. This proactivity includes reviewing an air carrier’s management, corporate safety culture, and its experience, as well as the airline’s systems.

Space Transportation Vehicle Safety will establish an FAA process to address all aspects of space flight operations. In addition, the FAA works with the Air Force to establish common safety standards for military and licensed launches.

Airport Management

Airport management services provide an airport system to satisfy the needs of the aviation community. Airport management also considers economic and environmental compatibility and local proprietary rights while safeguarding the public investment. The FAA provides regulation compliance guidelines, standards, funding authority, funding grants, and certification for airport planning, development, operations, and maintenance. Airport management is organized into aircraft ground operations, aircraft support, airport operations (including passenger, baggage, cargo, ground transportation, and other support services), airport development, and airport infrastructure information management services.

Security

Security services protect users against terrorist and other criminal acts and protect NAS facilities, equipment, and employees. These services include providing physical security for air traffic and airport facilities, security for passengers, and information security.

There is currently a heightened awareness of security in the aviation industry. The Aviation and Transportation Security Act (ATSA), Public Law 107-71, was passed on November 19, 2001. ATSA requires additional qualifications for screeners, including U.S. citizenship and increased training and testing.

Airport security

Under ATSA, by November 19, 2002, the responsibility for inspecting persons and property carried by aircraft operators and foreign air carriers is transferred to the Under Secretary of Transportation for Security, who heads a new agency created by that statute, the TSA.

> "For our airways, there is one supreme priority: security."
>
> George W. Bush, President of the United States

The FAA has pursued numerous research initiatives to help the TSA ensure that all security technologies viable in the fight against terrorism are considered. In October 2001, the FAA Security Research and Advisory Committee began evaluating over 1,000 technology recommendations from industry sources. Also in 2001, the FAA sponsored its Third International Aviation Security Technology Symposium in Atlantic City, where vendors' security technologies were on display.

More than 160 Explosives Detection Systems (EDS) have been deployed to airports across the country. More than 2,000 EDS must be deployed to meet the December 31, 2002, goal of 100 percent EDS screening of all checked bags. The FAA is also pursuing Argus, an initiative to develop a smaller and less expensive EDS to use at smaller airports.

In addition to the EDS, the FAA is currently purchasing Explosives Trace Detection (ETD) devices from three vendors with FAA-approved products. The FAA has installed more than 850 ETD devices in airports across the country.

Information Security

The Information Systems Security (ISS) Architecture implements the Information Security framework, which complies with the FAA ISS policies and Security Certification and Authorization Process (SCAP), to provide an acceptable level of security to the NAS and Administration and Mission Support (A&MS) Systems. Security-related network hardware and software are being strategically and systematically distributed across the NAS and A&MS infrastructure to serve and protect sensitive resources.

System Complexity: Network managers are prepared to counteract the various attacks of computer criminals, hackers with malicious intent, or disgruntled workers, by implementing a measure of computer network security that deals with various computer and network security platforms, each with its own unique software and hardware authentications at endpoints, data integrity, and encryption. Each computer has unexpected vulnerabilities and failure modes. The security architecture provides an overall security management structure for the NAS and A&MS Systems to ensure a layered method of security to monitor and manage the overall FAA architecture infrastructure.

Layered Approach: An intrusion occurs when someone attempts to break into or misuse a system. The word "misuse" is broad, and can refer to a wide range of actions, from stealing confidential data to corrupting data and bringing the network down, causing a denial of service. The smallest element of intrusion detection data is referred to as an event. An event is an auditable occurrence on the network. Layered security allows protection of the network at various points via a number of security devices. The challenges in securing a computer network can be viewed in three stages:

1. Prevention: to avoid intrusions, if possible;
2. Detection: to know as soon as possible when an intrusion attempt occurs; and
3. Reaction: to respond to an intrusion and to detect and prevent it in the future.

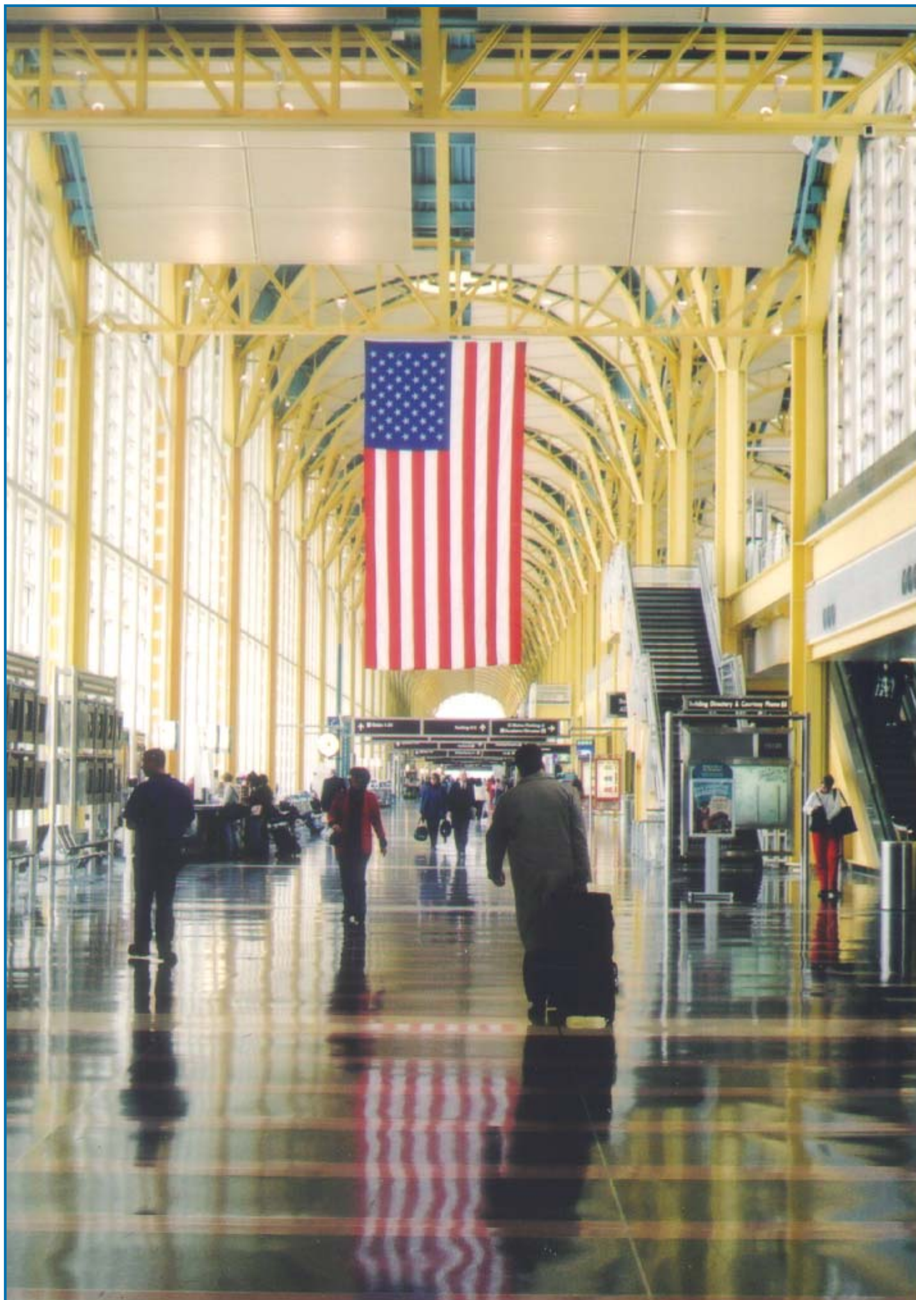
Manageable Security Devices: Manageable security devices are key to knowing, at all times, the current health of an entire network. With these devices, a network can be managed, monitored, and upgraded from a centralized remote location, if desired. Key security-related devices include: routers, firewalls, switches, virus protection patches, virtual private networks, and intrusion detection devices.

Security Management: Security management is paramount to controlling remotely, managing, distributing, and enforcing security policies across the NAS and A&MS systems. This will enable the FAA to share security devices and features and to upgrade numerous systems with the latest security technologies available in a cost-effective and timely manner. Security management allows for a more in-depth and layered approach to protection. Each system, prior to being integrated into the NAS, must go through a detailed SCAP procedure. The SCAP eliminates and/or mitigates all associated security-related risks. The mitigation of risk not only applies to the system/network being certified, but to all associated risks possibly generated as a result of all applicable interfaces to the system/network.

Future: Security procedures evolve constantly to counteract new cyber attacks with the latest security-related technologies to provide security for all NAS and A&MS systems.

Business Management

Business management services are provided by the FAA to operate the NAS effectively and deliver cost-effective services to the aviation community and other stakeholders and users. Business management includes acquiring systems, administering regional operations, providing depot maintenance and logistics support, and training personnel.



Airport terminal

8. The Future

Aviation plays a vital role in the U.S. and global economies. The NAS must support the needs of the aviation community. The FAA is committed to meeting NAS user needs through modernization; the FAA will deploy systems and implement procedures per the NAS Architecture to provide enhanced services.

Research & Development (R&D)

NASA is a key partner with the FAA. Portions of the OEP reflect this partnership. NASA provides crucial R&D on ATM technologies. FAA and NASA develop advanced ATC support tools, improve training efficiency, enhance safety through human factors research, and develop and test advanced CNS systems.

NASA researches, develops, and verifies new technology that the FAA may introduce into the NAS. The FAA is working on technologies to help with aircraft flow, including high-altitude aircraft, into busy airports. Additionally, a flexible SMS that will reduce arrival and departure delays is being investigated. These are just two examples of the many next-generation technologies being evaluated.

Commercial Space Transportation

Commercial space launch

Since the passage of the 1984 Commercial Space Launch Act and the ban of commercial payloads from flying aboard the Space Shuttle after the Challenger disaster in the mid-1980s, the U.S. commercial launch industry has emerged as a viable alternative for access to space for both commercial and government payloads. Today, commercial vehicles remain the only mode of transportation to space available in the U.S. for non-government payloads. U.S. launch vehicle manufacturers and service providers offer boosters of many sizes to accommodate a variety of lift-capacity needs and continue to introduce new vehicles into the market. The FAA conducted a study and documented the results of the economic impact of commercial space transportation on the U.S. economy (over $61.3 billion in 1999).

To support commercial space transportation, the FAA continues to work on the Space and Air Traffic Management System, the program for future integration of commercial space launch operations into the ATM system. In addition, the FAA evaluates proposed launch sites to issue licenses. The U.S. space launch ranges also support commercial space launches and are undertaking a series of programs to be upgraded and modernized.

Global Vision

The U.S. has the largest civil aviation infrastructure and the most civil aviation activities in the world. Yet, many other nations have developed unique aviation systems. International air travel requires compatibility between the U.S. and other nations in terms of CNS capabilities and technologies. This need will become more vital as modernization occurs throughout the world.

> "A successful future for aviation requires community consensus on core goals and strategies, strategic investment in new aircraft and new avionics, improved and expanded facilities, new and enhanced technologies, and a trained, experienced workforce in the air and on the ground."
>
> Charles E. Keegan,
> Associate Administrator
> Research and Acquisitions

The FAA also continues to work closely with the ICAO and its other members in establishing international standards that make global air travel safe and efficient. Currently, work is being done to implement Required Navigation Performance, develop Required Communications Performance and Required Surveillance Performance, standardize data link structure, and promote worldwide application of GPS.

The FAA has always been an active participant in developing new capabilities for civil aviation and will continue to play a major role in providing technology and training to many nations of the world.

Appendix A - Acronym List

A&MS	Administration and Mission Support
AD	Arrival and Departure Rate
ADS	Automatic Dependent Surveillance
ADS-A	Automatic Dependent Surveillance - Addressable
ADS-B	Automatic Dependent Surveillance - Broadcast
aFAST	active Final Approach Spacing Tool
AFSS	Automated Flight Service Station
AIR-21	Wendell H. Ford Aviation Investment and Reform Act for the 21st Century
AMASS	Airport Movement Area Safety System
AOC	Airline Operations Center
ARSR-4	Air Route Surveillance Radar - Model 4
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
ARTS-III	Automated Radar Terminal System - Model III
ASAP	Aviation Safety Action Program
ASDE	Airport Surface Detection Equipment
ASDE-3	Airport Surface Detection Equipment - Model 3
ASDE-X	Airport Surface Detection Equipment - Model X
ASOS	Automated Surface Observing System
ASR	Airport Surveillance Radar
ASR-7/8	Airport Surveillance Radar - Models 7 and 8
ASR-9	Airport Surveillance Radar - Model 9
ASR-11	Airport Surveillance Radar - Model 11
ATC	Air Traffic Control
ATCBI	Air Traffic Control Beacon Interrogator
ATCBI-4/5	Air Traffic Control Beacon Interrogator - Models 4 and 5
ATCBI-6	Air Traffic Control Beacon Interrogator - Model 6
ATCSCC	Air Traffic Control System Command Center
ATM	Air Traffic Management
ATOP	Advanced Technologies and Oceanic Procedures
ATOS	Air Transportation Oversight System
ATSA	Aviation and Transportation Security Act
AVOSS	Advanced Vortex Spacing System
AW	Airport Weather
CAA	Civil Aeronautics Administration
CAB	Civil Aeronautics Board
CAST	Commercial Aviation Safety Team
CAT	Category (e.g., CAT I ILS, CAT II ILS, or CAT III ILS)
CATS-I	Capability Architecture Tool Suite - Internet
CCFP	Collaborative Convective Forecast Product
CCSD	Common Constraint Situation Display
CDM	Collaborative Decision Making
CDMnet	Collaborative Decision Making network
CDR	Coded Departure Route
CFIT	Controlled Flight Into Terrain

CIP	National Airspace System Capital Investment Plan
CNS	Communications, Navigation, and Surveillance
COTS	Commercial Off-The-Shelf
CPDLC	Controller-Pilot Data Link Communications
CRCT	Collaborative Routing and Coordination Tools
CTAS	Center-TRACON Automation System
CY	Calendar Year
D2	Direct-To
DARC	Direct Access Radar Channel
DME	Distance Measuring Equipment
DOC	Department of Commerce
DoD	Department of Defense
DOT	Department of Transportation
DRVSM	Domestic RVSM
DSR	Display System Replacement
DUAT	Direct User Access Terminal
EALR	Equitable Allocation of Limited Resources
ECG	En Route Communications Gateway
E/DA	En Route/Descent Advisor
EDP	Expedite Departure Path
EDS	Explosives Detection System
ER	En Route Congestion
ERAM	En Route Automation Modernization
ESMS	Enhanced SMS
ETD	Explosives Trace Detection
ETMS	Enhanced Traffic Management System
EW	En Route Severe Weather
4CP	4 Cornerpost Project
4-D	4-Dimensional
F&E	Facilities and Equipment
FAA	Federal Aviation Administration
FCA	Flow Constrained Area
FDIO	Flight Data Input/Output
FDP	Flight Data Processor
FFP1	Free Flight Phase 1
FFP2	Free Flight Phase 2
FIS	Flight Information Service
FIS-B	Flight Information Service - Broadcast
FL	Flight Level
FOC	Full Operational Capability
FSM	Flight Schedule Monitor
FTI	FAA Telecommunications Infrastructure
GA	General Aviation
GBNA	Ground-Based Navigational Aids
GEO	Geostationary Earth Orbit
GDP	Ground Delay Program
GPS	Global Positioning System

HCS	Host Computer System
HID	Host Interface Device
HNL	HID NAS LAN
HOCSR	Host and Oceanic Computer System Replacement
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
IOC	Initial Operational Capability
ISS	Information Systems Security
ITU	International Telecommunication Union
ITWS	Integrated Terminal Weather System
kHz	Kilohertz
LAAS	Local Area Augmentation System
LAN	Local Area Network
LLWAS	Low Level Wind Shear Alert System
LLWAS-NE	Low Level Wind Shear Alert System - Network Expansion
LLWAS-RS	Low Level Wind Shear Alert System - Relocation/Sustainment
M&C	Monitor and Control
MAMS	Military Airspace Management System
MHz	Megahertz
MIAWS	Medium Intensity Airport Weather System
MicroEARTS	Micro En Route Automated Radar Tracking System
Mode S	Mode Select
NADIN	National Airspace Data Interchange Network
NAR	National Airspace Redesign
NARP	National Aviation Research Plan
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
navaids	navigational aids
NDB	Nondirectional Beacons
NEXCOM	Next Generation Air/Ground Communications System
NEXRAD	Next Generation Weather Radar
NICS	NAS Interfacility Communications System
NIMS	NAS Infrastructure Management System
NIRS	Noise Integrated Routing System
nmi	nautical mile
NOCC/OCC	National/Operations Control Center
NORAD	North American Aerospace Defense Command
NOTAM	Notice To Airmen
NTSB	National Transportation Safety Board
NWS	National Weather Service
OASIS	Operational and Supportability Implementation System
ODAPS	Oceanic Display and Planning System
OEP	Operational Evolution Plan
PAMRI	Peripheral Adapter Module Replacement Item
PARR	Problem Analysis Resolution and Ranking

pFAST	passive Final Approach Spacing Tool
POET	Post Operations Evaluation Tool
PPS	Precise Positioning Service
R&D	Research and Development
R,E&D	Research, Engineering, and Development
RIRP	Runway Incursion Reduction Program
RMT	Route Management Tool
RNAV	Area Navigation
RVSM	Reduced Vertical Separation Minima
SAMS	Special Use Airspace Management System
SCAP	Security Certification and Authorization Process
SDAT	Sector Design Analysis Tool
SDP	Surveillance Data Processor
SF-21	Safe Flight 21
SLEP	Service Life Extension Program
SMA	Surface Movement Advisor
SMS	Surface Management System
SMT	Sector Management Tool
SPS	Standard Positioning Service
SPT	Strategic Planning Teleconference
STARS	Standard Terminal Automation Replacement System
SUA	Special Use Airspace
TACAN	Tactical Air Navigation
TDWR	Terminal Doppler Weather Radar
TFM	Traffic Flow Management
TIS-B	Traffic Information Service - Broadcast
TMA	Traffic Management Advisor
TMA-MC	Traffic Management Advisor - MultiCenter
TMA-SC	Traffic Management Advisor - Single Center
TRACON	Terminal Radar Approach Control
TRB	Transportation Research Board
TSA	Transportation Security Administration
TSD	Traffic Situation Display
TWIP	Terminal Weather Information for Pilots
UAT	Universal Access Transceiver
URET	User Request Evaluation Tool
VDL-3	VHF Digital Link - 3
VHF	Very High Frequency
VOR	Very High Frequency Omnidirectional Range
WAAS	Wide Area Augmentation System
WARP	Weather And Radar Processor
WINS	Weather Information Network Server
WSP	Weather Systems Processor

Related Web Sites

Blueprint for NAS Modernization 2002 Update: http://www.faa.gov/nasarchitecture/Blueprint2002.htm

FAA Home Page: http://www.faa.gov/

FAA Directory of Plans: http://www.apo.data.faa.gov/dirplans/

Plans, reports, and initiatives mentioned in this Update:

- Airport Capacity Benchmark Report: http://www.faa.gov/events/benchmarks/
- Aviation Capacity Enhancement Plan: http://www.faa.gov/ats/asc/ace.html
- Blueprint for NAS Modernization (January 1999): http://www.faa.gov/nasarchitecture/blueprnt/index.htm
- CATS-I: http://www.nas-architecture.faa.gov/cats
- Concept of Operations for the National Airspace System in 2005: http://www.nas-architecture.faa.gov/Documents/Opscon.PDF
- National Airspace Redesign (NAR): http://www.faa.gov/ats/nar/
- NAS Architecture Version 4.0: http://204.108.10.116/nasiHTML/nas-architecture/index.html
- NAS Capital Investment Plan: http://www.faa.gov/asd/cip03/FY03cip.htm
- FAA Aerospace Forecasts 2002-2013 (March 2002): http://api.hq.faa.gov/strategicgoals/docs/Forecast2001.html
- FAA Strategic Plan: http://www.apo.data.faa.gov/dirplans/docs/SP2001.html
- Free Flight: http://ffp1.faa.gov/home/home.asp
- NAS Operational Evolution Plan: http://www.faa.gov/programs/oep/
- National Aviation Research Plan: http://204.108.10.116/nasiHTML/RED/narp02/index1.html
- Safe Flight 21: http://www.faa.gov/safeflight21/index.html
- Safer Skies: http://www.faa.gov/apa/safer_skies/saftoc.htm
- STARS: http://www.faa.gov/ats/atb/ATBSectors/Automation/STARS/stars.html
- System Safety Handbook: http://www.asy.faa.gov/Risk/SSHandbook/cover.htm

Government and Related Organizations:

- ATCSCC: http://www.fly.faa.gov/
- Department of Defense: http://www.dod.gov/
- FAA Research, Engineering and Development Advisory Committee: http://research.faa.gov/aar/redac.asp
- ICAO: http://www.icao.org/
- International Telecommunication Union: http://www.itu.int/home/index.html
- International Trade Administration: http://www.ita.doc.gov/
- NASA: http://www.nasa.gov/
- National Transportation Safety Board: http://www.ntsb.gov/
- National Weather Service: http://www.nws.noaa.gov/
- NAV CANADA: http://www.navcanada.ca/
- Office of Management and Budget: http://www.whitehouse.gov/omb/
- Office of Space Commercialization: http://www.ta.doc.gov/space/about/faq.shtml
- RTCA: http://www.rtca.org/
- Transportation Research Board: http://www.nationalacademies.org/trb/
- Transportation Security Administration: http://www.tsa.gov/
- Links to civil aviation authorities around the world: http://www.faa.gov/asd/international/civilauth.htm

Appendix B - Additional NAS Systems

System	Current Status & Future Plans
ARSR-4 Air Route Surveillance Radar - Model 4 is a long-range, three-dimensional, rotating phased array, primary radar system with coverage of 250 nmi. The system provides several improvements over other long-range radar systems, including improved target detection and better weather data. It is part of the Joint Surveillance System (JSS) used in conjunction with ARSR-3 coverage as part of the nationwide air defense command surveillance network. In addition to functions particular to the military, the ARSR-4 performs the same basic functions of the ARSR-3, by providing primary long-range surveillance data, including slant range and azimuth data for En Route operation.	There are 43 operational systems deployed around the periphery of the continental U.S., as well as in Guam, Hawaii, and Guantanamo Bay, Cuba. The ARSR weather data available on the En Route controller displays is being replaced by high-quality NEXRAD graphical weather data from WARP. Because most tracking is performed with beacon rather than primary radar data, and because ARSRs are expensive to maintain, they were to have been decommissioned when WARP became operational. However, recent events have reinforced the need to continue operation.
ASR-9 Airport Surveillance Radar - Model 9 is a short-range (60 nmi) primary surveillance radar system for the airport terminal area. The ASR-9 has a separate weather channel with associated processing capable of providing six-level weather contours. It is normally used in conjunction with Mode Select (Mode S) but it can accommodate an ATCBI-4/5. ASR-9s also feed the En Route automation systems to fill gaps in coverage from long-range radars.	All ASR-9 systems are delivered and commissioned. Due to an increased number of power outages, equipment outages, Occupational Safety and Health Administration concerns, and diminishing manufacturing sources (obsolete parts), a Service Life Extension Program (SLEP) has been initiated. In December 2001, the FAA signed a contract for a Phase 1 SLEP study.
ASWON Aviation Surface Weather Observation Network will supply automated surface weather observations to meet the needs of pilots, operators, and air traffic personnel. ASWON includes five systems: Automated Surface Observing System (ASOS), ASOS Controller Equipment Information Display System (ACE-IDS), Automated Weather Observing System (AWOS), Stand-Alone Weather Sensors (SAWS), and Automated Weather Sensors Systems (AWSS). ASOS, AWOS, and AWSS provide current surface weather observations to pilots and air traffic controllers. ACE-IDS displays operational and administrative data to air traffic controllers. SAWS is intended to be a back-up system to ASOS at up to 270 Level C airports.	There are 569 FAA-sponsored ASOS sites commissioned and 180 FAA AWOS units. Seven ACE-IDS have been installed. About 20 SAWS are installed to date. One AWSS unit has been installed. Plans include product improvements and upgrades for the ASOS. Also, additional ACE-IDS and AWSS units will be deployed and 250 additional SAWS units will be installed.
CDTI Cockpit Display of Traffic Information will provide the platform for displaying position (latitude, longitude, and altitude) and heading data for nearby aircraft to the pilot(s). Terrain information, moving maps, and other situational awareness information can also share this display. CDTI is used in conjunction with ADS-B for air-to-air "see-and-avoid" applications and can receive traffic data from multiple sources (ADS-B, TIS-B, Traffic Alert and Collision Avoidance System [TCAS], etc.). The CDTI can also be integrated with other functions such as weather, navigation, and terrain information for a multifunction display.	There are multiple vendors who are offering CDTI systems. Some are being evaluated in the SF-21 program. Supplemental-Type Certificate (STC) approval for installation of ADS-B/CDTI on two aircraft types has been received. A concept of operation for CDTI Enhanced Flight Rules is being developed. The SF-21 program office is supporting the effort to obtain STC approval for Surface Moving Map functionality on those aircraft with CDTI displays and will continue the activities associated with development and use of procedures for CDTI and "Electronic Flight Rules" in the terminal environment.

System	Current Status & Future Plans
Common ARTS ARTS programs have a common air traffic control mission with similar functional requirements. Common ARTS provides identical COTS microprocessors and software developed in a high order language. Common ARTS has been implemented at 131 small-to-medium-sized TRACONs as ARTS IIE systems and at 6 large TRACONs as ARTS IIIE systems.	Common ARTS operational deployment began in 1997. It will remain the primary Terminal automation system until it is replaced with STARS.
DSR Display System Replacement provides continuous real-time, automated support to air traffic controllers for the display of surveillance, flight data, and other critical control information. DSR consists of three types of consoles, Radar, Data, and Auxiliary, which are fed by two En Route automation systems, Host Computer System (HCS) as a primary source and Direct Access Radar Channel as a back-up source.	All DSR installations were completed in 2000. In 2002, WARP began providing improved weather radar mosaics of precipitation intensity data from NEXRAD to En Route controllers on DSR, integrated with surveillance targets. This enhances the ability of En Route controllers to provide weather safety advisories to aircrews and for traffic managers to conduct planning for alternate route selection around hazardous weather. The D-console is being upgraded by the URET program. The new console, a 20-inch flat panel mounted on an adjustable arm, will be fed by HCS (for legacy functions) and by the Conflict Probe (CP) processor. The console will be logically switchable between HCS and CP at the controller's option.
DUAT Direct User Access Terminal is a service that provides pilots convenient access to pre-flight aeronautical and weather information for flight planning. It allows pilots to input Instrument Flight Rules (IFR), ICAO, and Visual Flight Rules flight plans into the system.	DUAT processes over 600,000 transactions each month. The OASIS program will incorporate the DUAT services.
FANS 1/A Future Air Navigation System 1/A uses the Oceanic Data Link to provide ADS-A service in the Oceanic domain.	FANS 1/A is currently used in the Oceanic domain and over land areas in several non-U.S. regions of the world. FANS 1/A will continue to be used in the Oceanic domain for the foreseeable future.
FSA The Flight Schedule Analyzer consists of two parts: post-analysis FSA and real-time FSA. Post-analysis FSA graphically shows data and analysis results on how well a Ground Delay Program (GDP) performed and what factors impacted performance. Real-time FSA generates a collection of dynamic Web-based reports that allows the ATCSCC to monitor GDPs as they are executing.	Post-analysis FSA was deployed at the ATCSCC in April 2000. Real-time FSA was deployed in April 2001. Future planned enhancements include the delivery of an airline-tailored "Day after GDP performance report" to each airline.
HCS The Host Computer System processes surveillance reports and flight plan information in the ARTCC. The Host/Oceanic Computer System Replacement (HOCSR) Phase 1 replaced the main processors of the HCS, Oceanic Display and Planning System, and Offshore Flight Data Processing System. Phase 2 up-leveled NAS software to operate in the Native System/390 mode and provides a common monitor for En Route and Oceanic. Phase 3 replaces the Direct Access Storage Devices (DASDs) and provides minimal monitor and control capability for the DASDs. Phase 4 replaces the remaining peripherals.	HOCSR Phases 1 and 2 are complete. Phase 3 is scheduled to be completed in 2003. ERAM will replace the HCS.

System	Current Status & Future Plans
MicroEARTS The Micro En Route Automated Radar Tracking System is a radar processing system for use in both En Route and Terminal environments. Additionally, MicroEARTS supports a combination of Oceanic and En Route functions in Anchorage, AK. The system provides single sensor and mosaic display of traffic and weather, using long- and short-range radars. In Anchorage, MicroEARTS also supports ADS-B input processing and display. MicroEARTS supports multiple types of displays, including DSR, DBRITE, and the flat panel tower controller displays.	FAA MicroEARTS are operational in Anchorage, Honolulu, Guam, and San Juan. Additionally, there are four MicroEARTS operated by the DoD. ATOP will replace the Anchorage MicroEARTS. STARS will replace the others. The FAA is investigating incorporating NEXRAD data onto MicroEARTS displays at various sites.
Mode S The Mode Select beacon system is a combined secondary surveillance radar (beacon) and ground-air-ground data link system designed to replace the aging Air Traffic Control Radar Beacon Systems (ATCRBS). Mode S is capable of common-channel interoperation with the current ATCRBS, thus has been phased in over an extended transition period. Mode S can operate in a stand-alone manner or in conjunction with Terminal or digitized En Route radars and provide radar-reinforced beacon reports.	There are 144 operational Mode S sites. Presently 108 of the nations' busiest airports have Mode S ground stations. The majority of aircraft landing at these airports have Mode S transponders. Mode S is used in TCAS and many other applications. Future plans include a SLEP.
PRM The Precision Runway Monitor provides the capability to conduct simultaneous IFR approaches to parallel runways spaced less than 4,300 feet apart, thus returning lost capacity, reducing delays, and improving fuel savings. Scanning four to five times faster than existing surveillance radars, PRM tracks and displays each aircraft and updates position and velocity every second. Air traffic controllers monitor the progress of each aircraft in real-time and issue directions as required to maintain safe aircraft separation.	PRM systems have been commissioned at the Minneapolis-St. Paul International Airport, Philadelphia, and Lambert-St. Louis International Airport. Additional systems are designated for New York's JFK Airport, San Francisco, and Atlanta, with commissioning scheduled to be completed by 2004.
RMMS The Remote Maintenance Monitoring System checks system performance to detect alarm or alert conditions and transmits appropriate messages to the Maintenance Processor Subsystem. RMMS initiates diagnostics tests and adjusts/changes system parameters or configurations when properly commanded.	There are approximately 5,000 RMMS units in service today. However, because the RMMS hardware and software components are at, or approaching, obsolescence they will be integrated into NIMS.
TAWS Terrain Awareness and Warning System uses advanced electronic technology equipment to provide a "look-ahead" capability that gives flight crews automatic aural and visual warnings of possible terrain hazards.	TAWS has been installed in more than 6,000 aircraft. TAWS is scheduled to be installed on 27 FAA aircraft during the next five years.
TCAS The Traffic Alert and Collision Avoidance System provides pilots information on the position of nearby aircraft as an aid to "see-and-avoid." The system also issues Traffic Alerts on aircraft that may be a collision threat. TCAS I is mandated on aircraft with 10 to 30 seats, although the more expensive TCAS II may be installed instead. TCAS II is a more sophisticated system which provides the information of TCAS I, and also analyzes the projected flight path of approaching aircraft and issues Resolution Advisories to pilots to resolve potential mid-air collisions. TCAS II is required in aircraft with more than 30 seats.	TCAS is mandatory for all aircraft carrying 30 passengers or more. On November 1, 2001, the FAA issued a Notice of Proposed Rulemaking, which states that TCAS, or an FAA-approved alternative, must be installed on cargo aircraft by October 31, 2003.

System	Current Status & Future Plans
TDWR Terminal Doppler Weather Radar is utilized for the detection of hazardous weather conditions such as wind shear, microbursts and gust fronts, winds, precipitation, thunderstorms, and turbulence at an airport. This weather information is provided to air traffic personnel on displays at Terminal facilities and to pilots via Terminal Weather Information for Pilots (TWIP).	All 47 TDWR systems have been installed. In 2002, the FAA began replacing the TDWR radar product generator to improve system performance. Upgrades include new hardware and re-hosting software for the Digital Signal Processor and radar data acquisition and replacing antenna motors and hardened elevation drive bearings. Upgrades will continue with the addition of a 360^{o} detection scan plus other improvements to increase the detection capability of wind shear/microbursts and gust fronts.
UAT The Universal Access Transceiver is a radio data link system supporting broadcast services including ADS-B, TIS-B, and FIS-B. The UAT data link is a remote mounted radio that provides communication capability between aircraft and the ground.	UAT is currently being used in the SF-21 program. Plans include completing RTCA UAT Minimum Operational Performance Standards and UAT ICAO Standards and Recommended Practices. UAT will continue to be used in the SF-21 program.
VDL-3 VHF Digital Link Mode-3 was selected as the technology for the future air/ground communication system. The VDL-3 system will provide multiple channels to operate on one 25-kHz frequency assignment. The system will utilize Differential 8 Phase Shift Keying and employ 4.8 kilobits per second vocoders for voice operation. While current planning calls for operating the system in a 2-voice/2-data configuration, other combinations are also supported. In the fully operational state, the system will accommodate both voice and data and will have the flexibility to determine how the channel resources are applied for voice and data.	Under agreements with three vendors, the FAA will partially fund development of VDL-3 avionics. Standards for the VDL-3 system have been validated with implementation and operational validation soon to be initiated. The NEXCOM radio will use VDL-3 technology.
WSD The Web Situation Display is a browser-based version of the Traffic Situation Display used by the ETMS.	There are approximately 350 current users of WSD and the number continues to grow.

Appendix C - Selected System Locations

System (number)	Locations
ASDE-X (25 + 8 ASDE-3 upgrades)	*Operational Readiness Dates: FY 2003: Orlando (MCO); Milwaukee (MKE) FY 2004: Providence (PVD); Chicago Midway (MID) FY 2005: Ft. Lauderdale (FLL); Burbank (BUR); Houston Hobby (HOU); San Antonio (SAT); Albuquerque (ABQ); Raleigh-Durham (RDU); Honolulu (HNL); Ontario, CA (ONT) FY 2006: Phoenix (PHX); Indianapolis (IND); Tampa (TPA); Hartford (BDL); Columbus (CMH); San Jose (SJC); Colorado Springs (COS); Santa Ana (SNA); Oakland (OAK) FY 2007: Austin (AUS); Reno (RNO); Sacramento (SMF); San Juan (SJU) ASDE-3 sites upgraded with ASDE-X technology: FY 2004: Charlotte (CLT) FY 2005: Louisville (SDF); Dallas/Fort Worth (DFW); Chicago O'Hare (ORD); Los Angeles (LAX); Atlanta (ATL); Memphis (MEM); St. Louis (STL)
ASR-11 (112)	*Commissioning Dates: 2003: Stockton, CA; Anchorage, AK; Boise, ID; Fresno, CA; Lincoln, NE; West Palm Beach, FL; Erie, PA; Fairbanks, AK; Billings, MT; Merced, CA; Bangor, ME; Akron/Canton, OH; Burlington, VT; Lafayette, LA; Springfield, MO; Waco, TX 2004: Muskegon, MI; Little Rock, AR; Peoria, IL; Lansing, MI; Rochester, MN; Flint, MI; Fort Smith, AR; Melbourne, FL; Vero Beach, FL; Pensacola (South), FL; Abilene, TX 2005: Macon, GA; Columbus, GA; Rome-Griffiss, NY; Baton Rouge, LA; Beaumont, TX; Fort Myers, FL; Eugene, OR; Santa Maria, CA; Columbia, SC; Bristol/Tri-Cities, TN; Morristown, NJ 2006: Roanoke, VA; Rockford, IL; Greenville-Greer, SC; Midland, TX; Kahului (Maui), HI; Fargo, ND; Gulfport, MS; Allentown, PA; Colorado Springs, CO; Green Bay, WI; Lexington, KY; Santa Barbara, CA; Williams AFB, AZ; Monterey, CA; Fort Wayne, IN; Youngstown, OH; Sioux City, IA; Saginaw, MI; Augusta, GA; Myrtle Beach, SC 2007: Reno, NV; Mobile, AL; Champaign, IL; Wilkes-Barre, PA; Ashville, NC; Great Falls, MT; Falmouth-Otis (Cape Cod), MA; South Puget Sound, WA; Bakersfield, CA; Charleston, WV; Savannah, GA; Amarillo, TX; Duluth, MN; Reading, PA; Casper, WY; Wilmington, NC; Kalamazoo, MI; Springfield, IL; Huntington, WV; Hilo (Hawaii), HI; Jackson, MS; Longview-Tyler, TX; Evansville, IN; Corpus Christi, TX 2008: South Bend, IN; Waterloo, IA; Tallahassee, FL; Tualatin Valley, OR; Clarksburg, WV; Lake Charles, LA; Sioux Falls, SD; San Juan, PR; Terre Haute, IN; Binghamton, NY; Pueblo, CO; Elmira, NY; St. Thomas, VI; Mansfield, OH; Monroe, LA; Moline, IL; Bismarck, ND; Florence, SC; Chattanooga, TN; Andersen AFB, GU; Lihue (Kauai), HI; Minneapolis-St. Paul, MN; Morgan City, LA; St. Louis (Radar #2), MO 2009: K. I. Sawyer AFB, MI; Santa Fe, NM Currently Unfunded: Keahole, HI; Palm Springs, CA; Chicago O'Hare (Radar #3), IL; Paine-Everett, WA

System (number)	Locations
ATCBI-6 (124)	*Commissioning Dates: 2002: Tinker AFB, OK; Putnam, OK; Monroe, OR; Haleyville, AL; Puu Niauniau (Maui), HI; Chelsea, OK 2003: Crossville, TN; Red Table Mountain, CO; Anson, TX; Seattle, WA; Oakdale (Pittsburgh), PA; Boron, CA; Eagle River, WI; Ashburn, GA; Alexandria, LA; Marrietta, GA; Higby, WV; Texarkana, AR; Brecksville (Cleveland), OH; Russellville, AR; Huntingburg, IN; Sacramento, CA; Byhalia (Memphis), MS; Pahoa, HI; Benton, PA; Grand Turk, BW; Apple Valley, MN; Samburg, TN; Skowhegan, ME; Rogers, TX; Cummington, MA; Lagrange, IN; Biorka Island, AK; San Pedro, CA; Maiden, NC; West Mesa, NM; Newport, MS; Middleton Island, AK; Joelton (Nashville), TN; London, OH; Houston, TX 2004: Dead Horse, AK; Hanna City, IL; Odessa, TX; St. Paul Island, AK; Montgomery, AL; Silver City, NM; Shemya, AK; Crocker, MO; Keller (Fort Worth), TX; Citronelle, AL; Hutchinson, KS; Coopersville, MI; Omaha, NE; Benson, NC; St. Louis, MO; Binns Hall, VA; Oskaloosa, KS; Indianapolis, IN; Lynch, KY; Horicon, WI; Kirksville, MO; Seligman, AZ; Lincolnton, GA; Bedford, VA; Arlington, IA; Clearfield, PA; Detroit, MI; Phoenix, AZ; Dansville, NY; Klamath Falls, OR; Fossil, OR; The Plains, VA; Elwood (Joliet), IL; Rocksprings, TX 2005: Tamiami, FL; Finley, ND; Fort Fisher, NC; Mill Valley, CA; Oilton, TX; Fort Green, FL; Kenai, AK; Caribou, ME; Mt. Santa Rosa, GU; Jedburg, SC; Deming, NM; Rainbow Ridge, CA; Cross City, FL; Gibbsboro, NJ; Makah, WA; Empire, MI; Malmstrom AFB (Bootlegger Ridge/Great Falls), MT; North Truro, MA; Key West, FL; Oceana, VA; Lake Charles, LA; Guantanamo Bay, CU; Riverhead (Suffolk), NY; Bucks Harbor, ME; Melbourne, FL; Mt. Laguna, CA; King Mountain, TX; Nashwauk, MN; Paso Robles, CA; Eagle Peak, TX; Ajo, AZ; Morales, TX; Whitehouse (Jacksonville), FL; Watford City, ND; Mt. Kaala, HI 2006: Tyndall AFB, FL; Slidell, LA; San Clemente Island, CA; Salem, OR; Utica, NY; Pico Del Este, PR; Lakeside, MT; Nassau, BH; Mica Peak, WA; Battle Mountain, NV; Freeport (Grand Bahama), BW; Georgetown, BW; San Antonio, TX; Yakutat, AK
ITWS (34)	*Commissioning Dates: 2002: Atlanta (ATL); Miami (MIA); Program Support Facility (PSF); FAA Academy (FAAAC) 2003: Kansas City (MCI); Houston (HOU); St. Louis (T75); Potomac Consolidated TRACON (PCT); Chicago MCF (C90); New York (N90) 2004: Boston (A90); Pittsburgh (PIT); Cincinnati (CVG); Detroit (DTW); Philadelphia (PHL); Indianapolis (IND); Denver MCF (D01); Cleveland (CLE) 2005: Orlando (MCO); Memphis (MEM); Dallas/Fort Worth (DFW); Minneapolis-St. Paul (M98) 2006: Charlotte (CLT); Dayton (DAY); Columbus (CMH); Louisville (SDF); Raleigh-Durham (RDU) 2007: Nashville (BNA); New Orleans (MSY); Las Vegas (LAS); Phoenix (P50); Salt Lake City (S56); Tulsa (TUL) 2008: San Juan (SJU); Wichita (ICT); Oklahoma City (OKC)
MIAWS (40)	(Schedule being rebaselined.) Fort Myers, FL; Jackson, MS; Midland, TX; Lexington, KY; Peoria, IL; Providence, RI; Green Bay, WI; Monroe, LA; Greer, SC; Springfield, MO; Little Rock, AR; Asheville, NC; Shreveport, LA; Daytona Beach, FL; Baton Rouge, LA; Augusta, GA; Fort Smith, AR; Tallahassee, FL; Lincoln, NE; Columbia, SC; Rochester, MN; Pensacola, FL; Billings, MT; Lansing, MI; Sioux City, IA; Fayetteville, NC; Moline, IL; Montgomery, AL; Omaha, NE; Columbus, GA; Sioux Falls, SD; Savannah, GA; San Francisco, CA; Mobile, AL; Roanoke, VA; Bristol/Tri-Cities, TN; Springfield, IL; Colorado Springs, CO; Chattanooga, TN; Charleston, WV

System (number)	Locations
STARS	*Hardware Delivery Dates: 2002: El Paso (ELP); Syracuse (SYR); Memphis (MEM); Bradley (BDL); Birmingham (BHM); Detroit (DTW); Albany (ALB); Albuquerque (ABQ); Providence (PVD); Las Vegas (LAS); Philadelphia (PHL); Omaha; Des Moines (DSM); Cleveland (CLE) 2003:Portland (PDX); Boston (BOS); Miami (MIA); Milwaukee (MKE); Tucson (TUS); Raleigh (RDU); San Antonio (SAT); Kansas City (MCI); Nashville (BNA); Port Colombus (CMH); Roswell (ROW); Rochester (ROC); Seattle/Tacoma (SEA); Moses Lake (MWH); Oklahoma City (OKC); Santa Barbara (SBA); Charlotte (CLT); Tulsa (TUL) 2004: Dayton (DAY); Buffalo (BUF); Salt Lake City (SLC); Cincinnati (CVG); Indianapolis (IND); Daytona Beach (DAB); St Louis (STL); Little Rock (LIT); Minneapolis-St. Paul (MSP); Denver TRACON; Pittsburgh (PIT); Wichita (ICT); Norfolk (ORF); New Orleans (MSY); Orlando (MCO); Phoenix (PHX); Shreveport (SHV); Chicago TRACON; Cedar Rapids (CID); Pensacola (PNX) 2005: Houston (IAH); Atlantic City (ACY); Grand Rapids (GRR); Portland (PWM); Toledo (TOL); Fort Wayne (FWA); Pasco (PSC); Madison (MSN); Lubbock (LBB); Jacksonville (JAX); Akron (CAK); Harrisburg (MDT); Bangor (BGR); Austin (BSM); Peoria (PIA); Eugene (EUG); Lansing (LAN); Tampa (TPA); Lafayette (LFT); Boise (BOI); Savannah (SAV); Erie (ERI); Lincoln (LNK); Burlington (BTV); West Palm Beach (PBI) 2006: Flint (FNT); Rome; Greensboro (GSO); Springfield (SGF); Palm Springs (PSP); Rochester (RST); Waco (ACT); Charleston (CHS); Roanoke (ROA); Aspen (ASE); Rockford (RFD); Huntsville (HSV); Muskegon (MKG); Montgomery (MGM); Springfield (SPI); Knoxville (TYS); Baton Rouge (BTR); Fort Smith (FSM); Fayetteville (FAY); Fort Myers (RSW); Colorado Springs Muni (COS); Gulfport (GPT); Green Bay (GRB); Billings (BIL); Kingsport (TRI); Fresno (FAT); Columbia (CAE); Fargo (FAR); Greer (GSP); Abilene (ABI); Lexington (LEX); Allentown-Bethlehem-Easton (ABE); Reno (RNO); Youngstown (YNG); Sioux City (SUX); Cape Cod; Charleston (CRW) 2007: Augusta (AGS); Duluth (DLH); Corpus Christi (CRP); Kalamazoo (AZO); Elmira (ELM); Saginaw (MBS); Great Falls (GTF); Mobile (MOB); Midland (MAF); Champaign (CMI); Wilkes-Barre (AVP); Wilmington (ILM); Spokane (GEG); Hilo (ITO); Asheville (AVL); Casper (CPR); Myrtle Beach (MYR); Evansville (EVV); Monroe (MLU); Florence (FLO); Amarillo (AMA); Bakersfield (BFL); South Bend (SBN); Waterloo (ALO); Reading (RDG); Jackson (JAN); Sioux Falls (FSD); Lake Charles (LCH); Huntington (HTS); Terre Haute (HUF) 2008: Tallahassee (TLH); Pueblo (PUB); Chattanooga (CHA); Louisville (SDF); Mansfield (MFD); Binghamton (BGM); Moline (MLI); Longview (GGG); Bismarck (BIS); Clarksburg (CKB); Meridian; New York TRACON; Dallas/Fort Worth TRACON; Atlanta TRACON; Northern California TRACON; Potomac TRACON *The STARS Home Page is the source of the above information. See that Web site for the most current information.*
*Please note that these schedules are subject to change. See CATS-I for up-to-date information.	